



IN the near future the Federal Treasurer will bring down his new budget, one of the most important in the history of the Government and of the nation. It will indicate whether he is alive to many of our economic problems, and whether he is prepared to revise his ideas in the light of them.

The radio industry is bearing a heavy burden of sales tax on receivers and receiver components. This tax shows that, despite Government assurances that radio is not considered a luxury, it is in fact being penalised as though it were. These two things just can't exist together. Its no comfort to know that although we are

paying a very high tax, radio is really classed as important enough to deserve better treatment. There is an old saying that handsome is as handsome does.

From various statements that have been made, we are led to hope that radio can expect some relief in the new budget. We are able to make a strong case for it. At the moment, manufacturers and radio traders are facing a severe recession in business, with drastically reduced sales and reduced staffs. This is due partly to prevailing conditions, and the greater reluctance of the public to buy items requiring any great outlay. But it is considerably aggravated by the terrific price increase following the sales tax slug.

In an effort to keep retail prices down, receivers have been produced which are not as good as they should be. We can scarcely blame manufacturers for this, because they are faced with the stark necessity of making the best of things.

Unfortunately we are going to need better sets, not poorer. The Broadcasting Board has approved big power increases for the national stations, and eventually the commercials must follow suit. Concentration of powerful stations, particularly in the metropolitan areas, will require greater care in receiver design, and may severely discriminate against large numbers of simple receivers now being sold.

We are beginning to realise that some types of war-time production such as aircraft and tanks, may never be economical or practicable for our limited manufacturing resources. But in time of war, or similar emergency, the radio industry will be invaluable to the nation.

The Government will be extremely shortsighted if it is not convinced now that substantial tax relief is essential. We must take every step to preserve our resources in manufacturing and brainpower so that the radio industry can respond if called upon.

Even if an emergency does not arise—and we sincerely hope it can be avoided—the people have a right to buy good receivers at a reasonable price, so that their essential contact with the rest of the world may be preserved. The foolish fallacy that radio is a luxury must be abandoned for good.

John Moyle

RADIO AND HOBBIES IN AUSTRALIA

A NATIONAL MAGAZINE OF RADIO, HOBBIES AND POPULAR SCIENCE

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OUR COVER PICTURE

A girl operator is shown using a laboratory instrument for assaying radio-active isotopes. The instrument consists of an air ionisation chamber and a quartz-fibre electrometer—the modern counterpart of the gold-leaf electroscope.



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Capacity 0.001-0.1 and 0.1-10 MFD.



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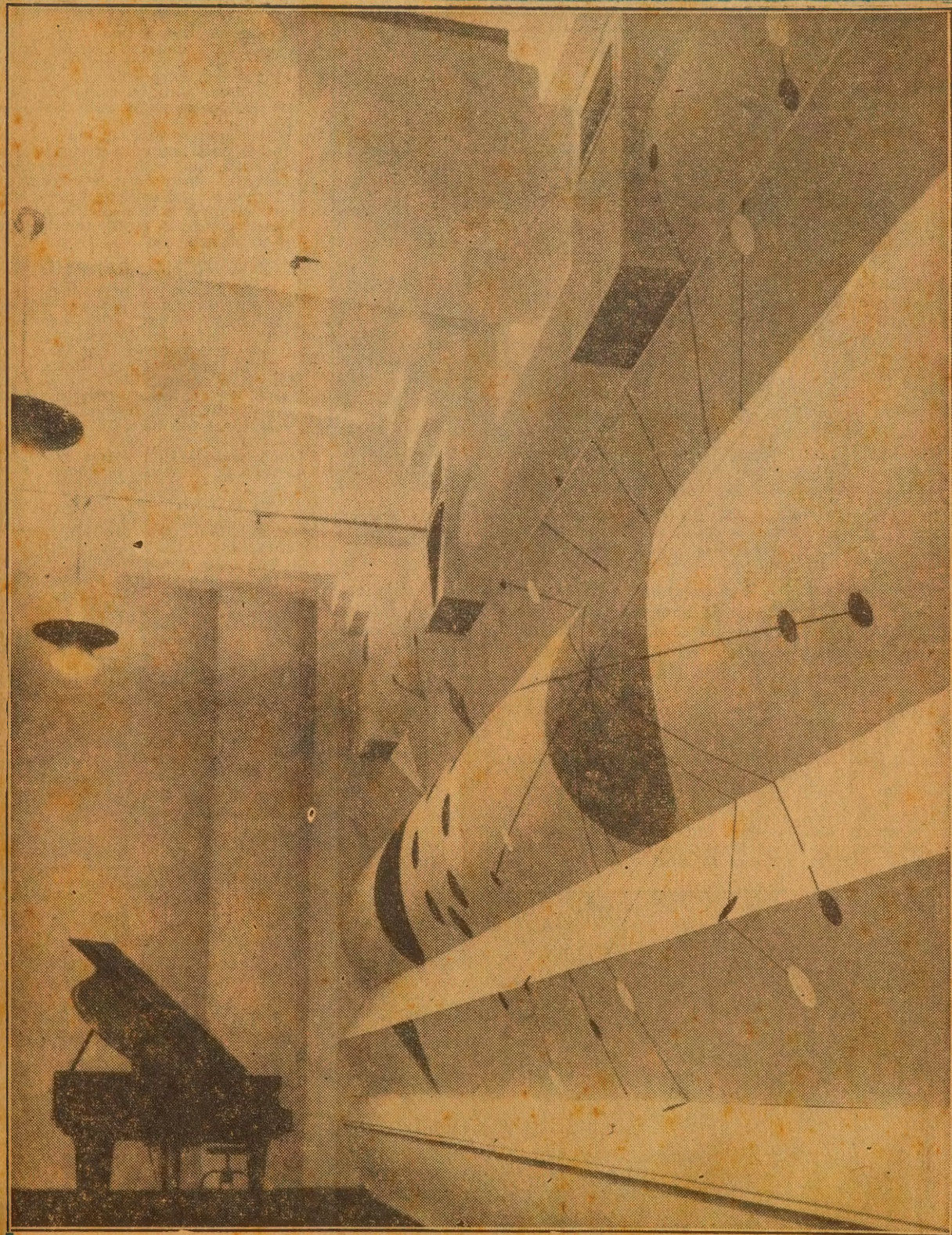
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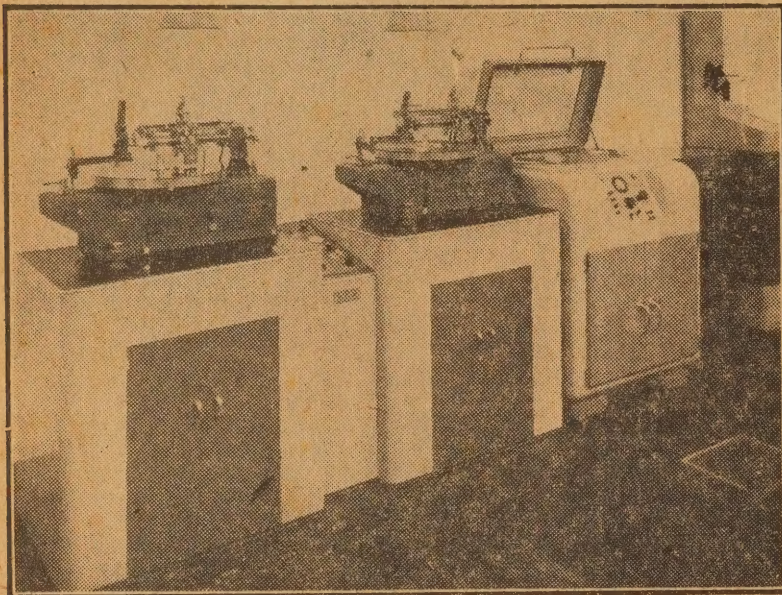
STUDIO MADE FOR MODERN RADIO



This corner of Station WOL's new main studio shows the use in combination of flat absorbent surfaces and curved, resonant reflectors. The broken surfaces of walls and ceiling prevent the build up of long reverberation but still preserve the essential liveness and brilliance so important to a realistic broadcast.

(SEE STORY NEXT PAGE)

ARTIST AND ENGINEER AT 2UE



In the recording room are two Presto disc recorders, two Emitape tape recorders, a Shadowgraph projector and other recording facilities. Almost any type of recorded program can be produced here.

A new set of studios is an event in the life of any broadcasting station. In them, the programs are born, the artists work, the personality of the place is made. Such studios will go on exerting their subtle influence over the station for many years to come, and must therefore be selected with the utmost care.

STATION 2UE, one of Sydney's leading commercials, recently welcomed home Mr. Murray Stevenson, its chief engineer, from a world tour. During his trip abroad, Mr. Stevenson became absorbed in this matter of studio design, and the possibilities of a new approach. When he returned, he set about building in Hosking House, some additions to 2UE's present facilities in Bligh

St. He visualised something which would look and sound completely different from the conventional.

The result has shocked many artists and engineers, but it's safe to say that they will all come back for a second look.

Having completed the construction, 2UE considered that a modern studio demanded modern decoration. Douglas Annand, Australian artist and

winner of the Sulman prize for murals was engaged for the work. He is responsible for the remarkable designs and color scheme which exhibit great skill in using the geometrical patterns of walls and ceilings.

The station now has a set of studios quite unlike anything else in Australia, and tests to date indicate that its brilliant decoration is matched by the brilliance of its performance. It is this quality of brilliance which is really the keynote of its design.

CONVENTIONAL DAMPING

Probably the two prime enemies of any studio are extraneous noises and unwanted echoes. No broadcast station can face the possibility of a stray word—always the wrong one—going out through its program, nor can it accept traffic sounds, footsteps, nor any other confusing noises which distract the listener. So much importance has been placed on these two things that most stations line their studios with sheets of sound-absorbing material to damp them out, and to flatten or kill echoes and reverberation. Such studios might be "dead safe," but it's safe to say that they are also dead—unexciting to use and to look at.

The main thought behind the new 2UE studios is that the programs originating from them should be interesting, alive, and cleanly defined. Highly absorbent walls kill the echoes, but they also kill brightness. The walls and ceilings at 2UE, therefore, have been broken into irregular surfaces, some sections acting as absorbers, and others as reflectors.

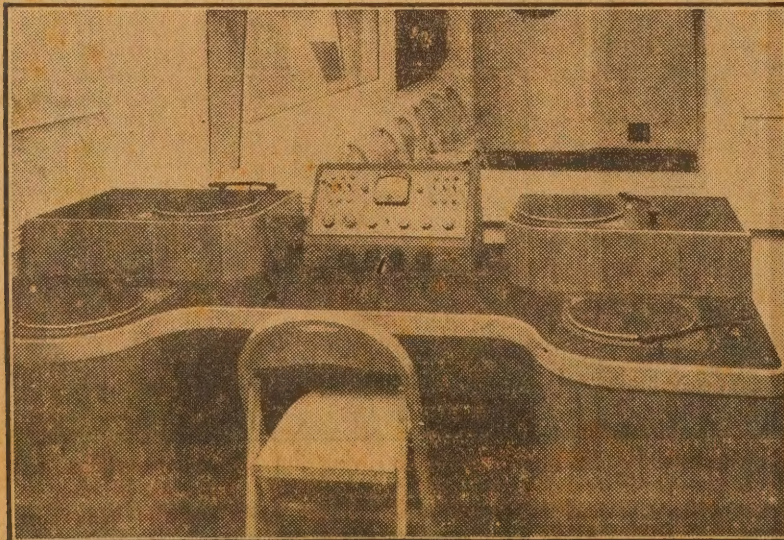
USE OF REFLECTION

The reflectors feature curved surfaces which, instead of reflecting the sound backwards and forwards to create long echoes, scatter it at various angles throughout the studios. Sections of these curved surfaces are tuned to different parts of the sound spectrum, so that there is little danger of certain sounds or combinations of sounds being favored at the expense of others.

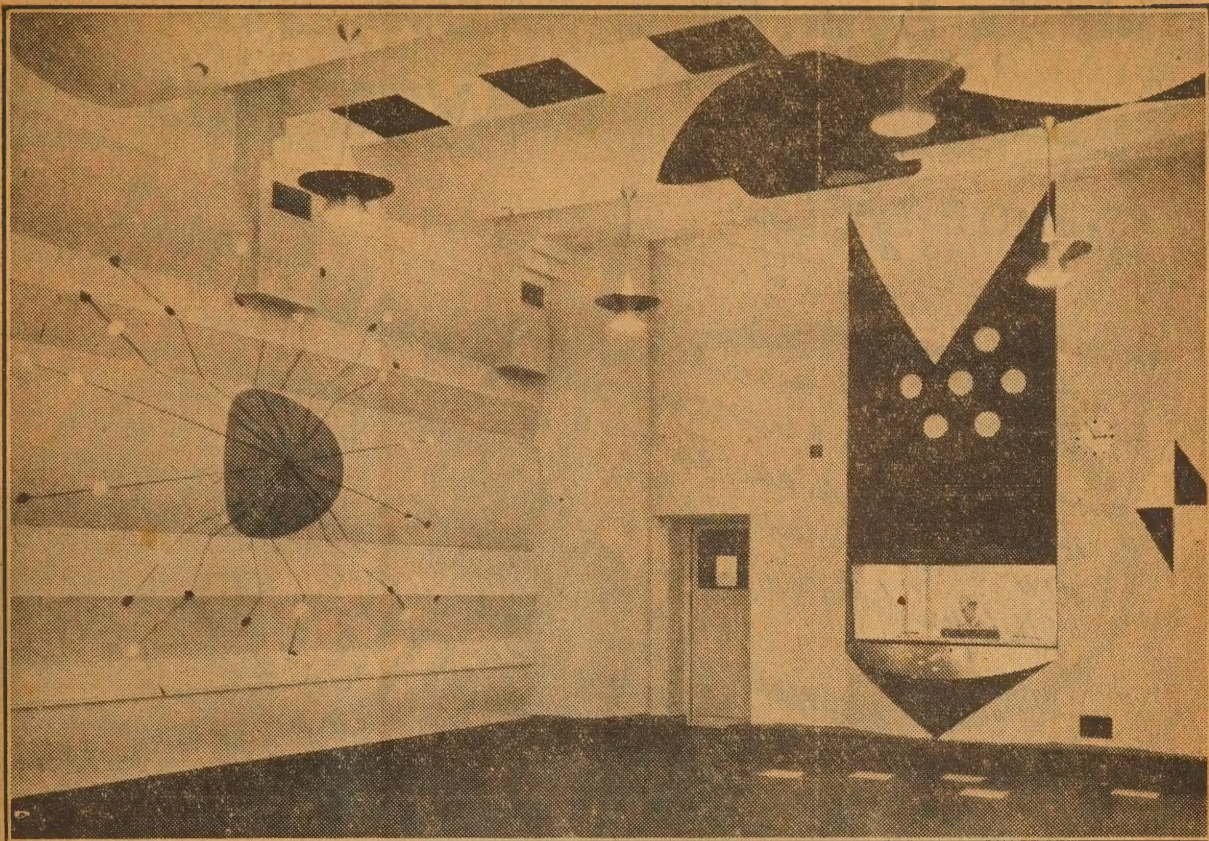
The balance of absorbers and reflectors has been worked out so that the studio sounds pleasantly alive. I isn't necessary to shout to be heard even in the large one. On the contrary, the voices seem to fill the entire studio without effort, and with complete relaxation on the part of the artist.

This conception of a broadcasting studio is becoming increasingly popular overseas, particularly in America. It is also found in the recording field, where extremely wide range technique is throwing greater emphasis on realism in acoustics.

We all know how disappointing many past recordings have been when made in conventional dead



A view of the new control booth which allows the producer and the control operator to work easily together.



The main studio looking in from the main entrance door. The control room window at the end looks like the vent in a huge organ pipe.

studios and halls, and how convincing others have been when the recording chamber has exhibited that subtle combination of liveliness and freedom from confusing echoes.

This is the problem which 2UE believes it has solved in its new venture.

Although the photographs show the general design adopted by Douglas Annand in his decoration, they cannot show the color scheme which is equally important. In general, the ceiling and walls are light grey, and the designs are done in strong red, yellow, blue and green. The floor of the main studio is made of black asphalt tiles, relieved by eleven light grey tiles patterned upon it.

MODERN DECORATION

Some of the architectural features are worked into the design. The window to the main control room at the end of the big studio is treated like a great organ pipe—there is a watchful eye motif at the entrance on a pillar reminiscent of a totem pole. But the general effect is abstract, so that the decorations serve mainly to break up the irregularity of walls and ceiling, and at the same time to create the atmosphere of vitality.

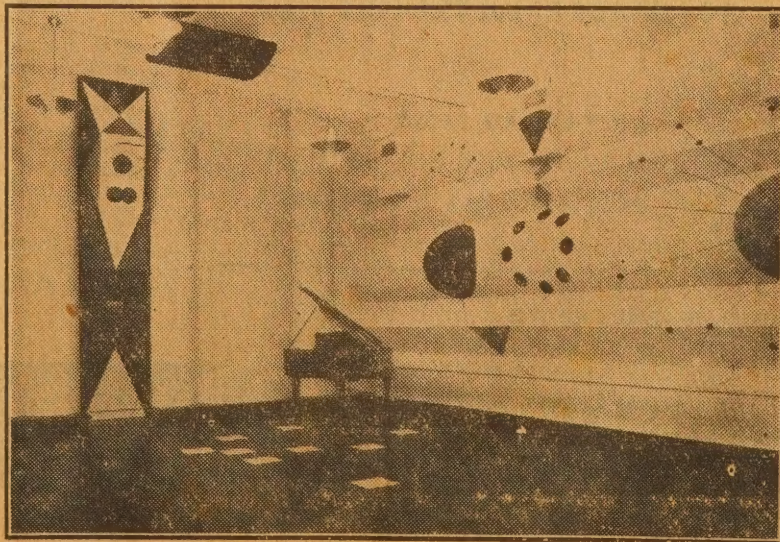
There are two small studios in addition to the larger hall, a new control room with four turntables, and a recording room housing facilities for recording on disc and tape. The three new studios, E, F, and G are in addition to studios A-D at Bligh St. Both sets are interconnected by lines so that they can operate together as though in the same building.

Mr. Stevenson has not finished experimenting with his new studios, particularly the smaller rooms. In fact, one of them he intends to treat as a guinea pig for working out several ideas he has in mind. While the general principles are the same, there are special effects to be aimed at in a small studio used mainly for talks which do not apply to an auditorium capable of holding quite a large orchestra.

By a judicious process of adding absorbent and reflective surfaces at strategic points, it is possible to raise

or lower the reverberation constant and to obtain other effects of sound distribution, which literally "tune" the studio for a given result. By a series of test recordings, it is possible to compare the actual results obtained from time to time, and finally to select the one most closely approaching the final goal.

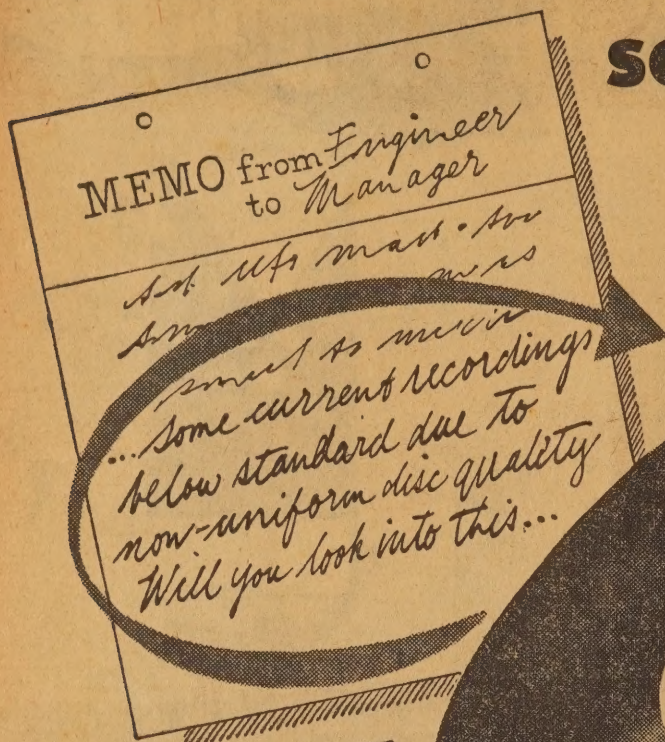
The studios were officially opened by the Postmaster-General, Hon. H. L. Anthony, in the presence of the chairman of directors, Sir John Butters, and a gathering of men prominent in the broadcasting world.



Looking down the main studio from the control booth end shows how the grey tiles have been used to relieve the black floor.

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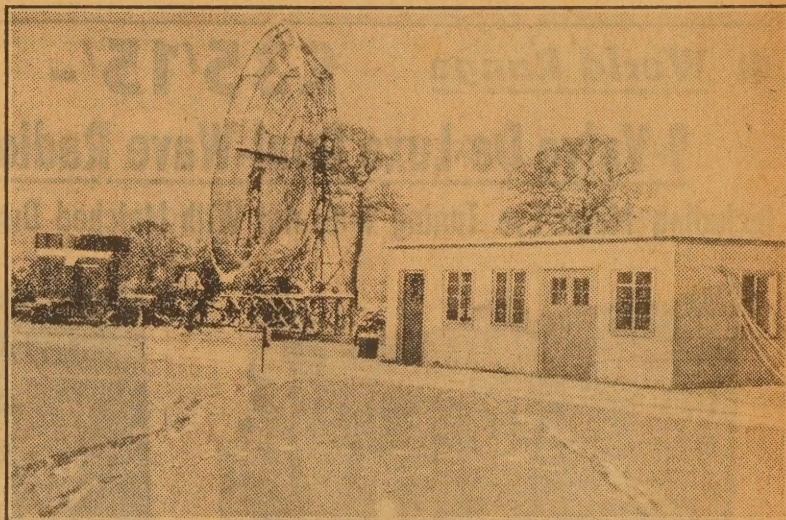
8 DORCAS STREET, SOUTH MELBOURNE.

ELECTRON AIDS TO ASTRONOMY

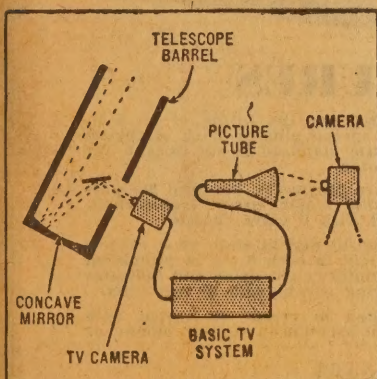
Just as the science of electronics has contributed enormously to microscopy, so now does it promise to widen the horizons of astronomy. There are two major lines of development—pure radio astronomy and the use of electronics to measure and even boost the light output from conventional telescopes.

EVEN with the huge 200-inch reflector in the Mt. Palomar telescope, the amount of light which can be collected and focused on to a photographic plate is extremely small and requires very long exposures before anything at all becomes visible. Some of the nebula, which have been photographed, apparently comparable to our own milky way, are as far as 360 million light years away. Theoretical limit to the telescope's range is a billion light years.

The 200-inch telescope at Mt. Palomar is the largest in the world, and it may transpire that no substantially larger reflector will ever be built. As it is, results are compromised very



A small radio telescope, as installed at the Jodrell Bank Experimental Station, in England. Diameter of the aerial cone is 30 feet.



By replacing normal photographic apparatus with an electronic system of light collection and amplification, the performance of an optical telescope may yet be enormously increased.

severely by atmospheric diffraction. Scientists are looking instead to the possibilities of increasing the capacity and versatility of existing telescopes by electronic means.

For example, the 48-inch wide-angle Hale telescope, with its Schmidt optical system, is being used with ultra-sensitive photocells to measure light intensity values far more accurately than could be done with the larger telescopes, relying on purely photographic means.

The measurement of light intensity and color is of major importance to astronomers.

Even more interesting is the possible application of television techniques actually to amplify the light collected by the telescope and make it immediately available to camera and viewer on a television screen.

Even ordinary television cameras, nowadays, are several times as sensi-

tive as photographic film and it is reckoned that the application of this technique, with electronic amplification of the light signals, would allow the Mt. Palomar telescope to yield results equivalent to those which would be obtained from a mirror 26ft across.

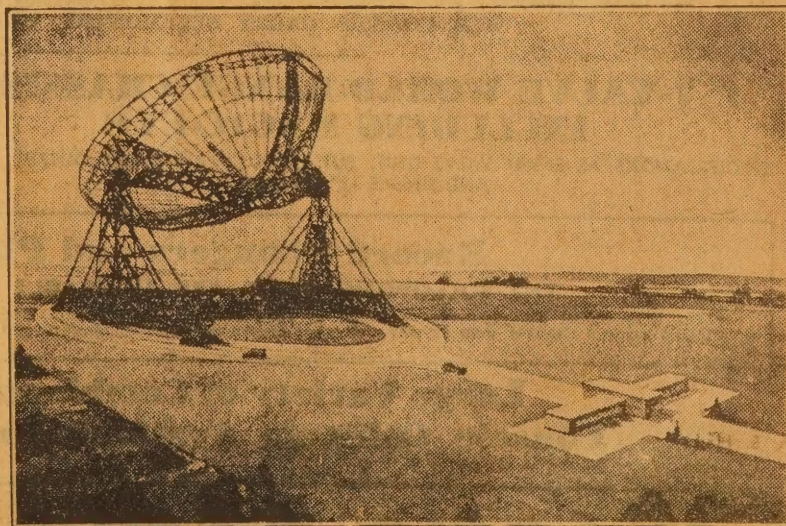
While this telescope is used frequently with photo-cells to measure light values, only very tentative experiments have yet been made with electronic amplification of the image.

Quite obviously the "TV" system would have to be designed to give extreme resolution, but this would appear much less a problem than that of producing larger and still larger mirrors.

Along completely different lines are the current experiments in radio astronomy—a field in which Australian scientists are doing much original research.

Huge directional aerial arrays collect radio energy from space in exactly the same way as ordinary telescopes collect light rays.

Radio astronomy has already suggested the existence of "black" stars—bodies which do not radiate light, and which, therefore, do not appear on ordinary photographic plates. It is suggested also that some radio energy stems from the change of hydrogen into helium, a mutation which is believed to be the source of the sun's radiant energy.



A scale drawing of a new giant radio telescope which is to be erected at Jodrell Bank. The mirror will be 250 feet in diameter, of wire mesh and, with its supporting structure will weigh 1270 tons. The aerial element will be at the tip of a pole 185 feet long, protruding from the centre of the cone. Cost of project is estimated at £336,000.

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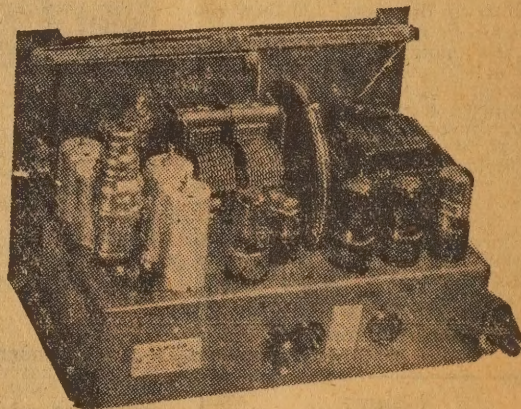
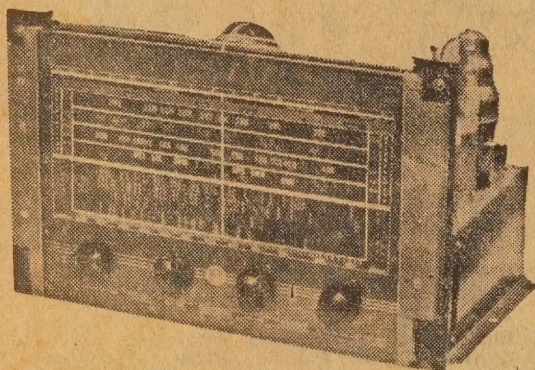
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TWIN CHANNEL SOUND ON ONE TAPE

Discussion arising out of a recent "Let's Buy An Argument" article has focused attention on two-channel or binaural sound reproduction. An article received recently from Ad. Auriema Inc., of New York, describes a Magnecord two-channel tape recorder and some experiments conducted therewith.

STEREOPHONIC or binaural sound reproduction has a similar relation to monaural or normal sound reproduction as stereoptic pictures have to normal pictures. By recording sound using two microphones placed approximately in the same positions as the ears in a listener's head, and then playing back the sound from each microphone through two earphones, the listener, wearing the earphones, gets a "third dimensional" effect.

Sounds in the reproduction seem to originate in the same locations as the original sounds.

This quality of binaural recording-reproducing system is extremely important whenever it is necessary to

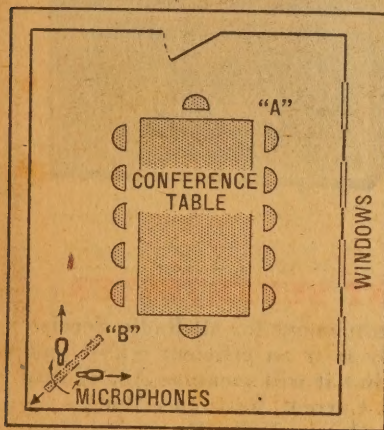


Figure 1: Microphone set-up for recording a small conference. Absorbent baffle "B" improves effect but may have to be moved towards corner with some microphones to pick up region "A" properly.

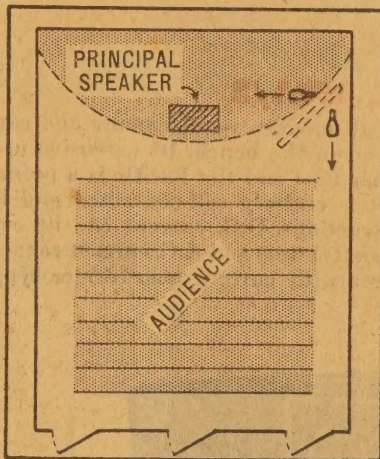


Figure 2: Suggested microphone placement for recording a lecture in typical auditorium. For playback conditions see figure 3, which are used for conference playback.

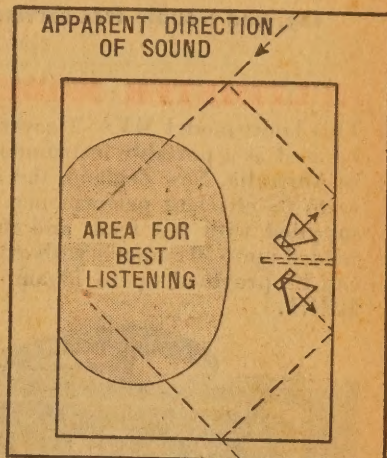


Figure 3: A typical listening set-up. Sound bouncing from side walls gives same effect as if speakers were to either side, beyond normal confines of the room.

reproduction with an upper frequency limit of 5 Kc is more pleasing, and in many cases, more useful, than a monaural or single channel recording with an upper limit of 10 Kc.

The actual techniques of making a stereophonic recording, and playing it back, very with each application. Certain typical recording problems are discussed here, and with this information, satisfactory recordings can usually be made by non-technical personnel.

CONFERENCE RECORDS

Binaural recording of conferences is almost the only way of obtaining an intelligible record of the conversations. The recordings of conferences show that much of the time, two or more people are talking simultaneously.

In a monaural recording, one or both conversations may be unintelligible, depending on the relative loudness of the two as they reach the

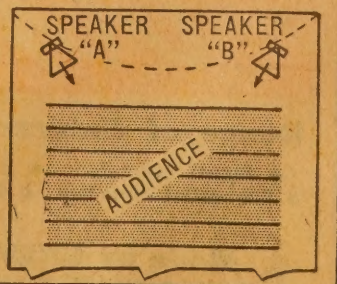
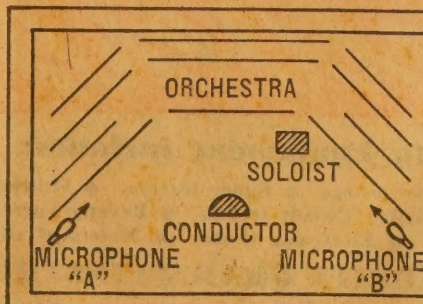
microphone. A loud voice, or a low voice close to the microphone, may mask completely the sound which is desired. Two equally loud voices may mask each other, and render both unintelligible.

Fig. 1 shows a typical room, with a recorder set up to cover a conference of twelve persons. It is very important that microphones having almost zero response in one hemisphere be used. For best results, a piece of acoustically "dead" material, such as acoustical tile, or heavy drapery, placed between the two microphones, as at "B" in Fig. 1, will insure that echoes and reverberations will be properly recorded by each unit.

For microphones with appreciable rear response, isolation between the two microphones is essential.

If one particular person is going to speak most of the time, as in an auditorium, where a lecture is followed by a question and answer

(Continued on Page 17)



Figures 4, 5: Typical microphone placement for recording a large orchestra and the equivalent speaker placement in a hall to serve a large audience.

listener to one sound in the presence of other sounds. Just as in "live" listening, the listener is able to concentrate on one or the other sound, using his normal directive hearing abilities.

Tests made at the Armour Research Foundation, in Chicago, have shown that the directive effect of a stereophonic recording can be preserved with a variety of microphone positions and also with a variety of loudspeaker locations. Earphones are obviously not suited for high fidelity recordings or for group listening.

The basic elements of the Magnecord Binaural system are a twin head recorder, and a dual record-reproducing amplifier. Together with these units, two high quality microphones are necessary. These elements will give very high fidelity reproduction, such as would be necessary in the recording of music.

However, a much less expensive system can be used for many industrial applications and for conference recording. Tests have shown that a binaural or two-channel stereophonic

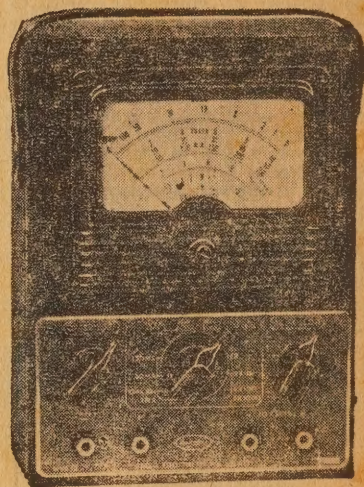
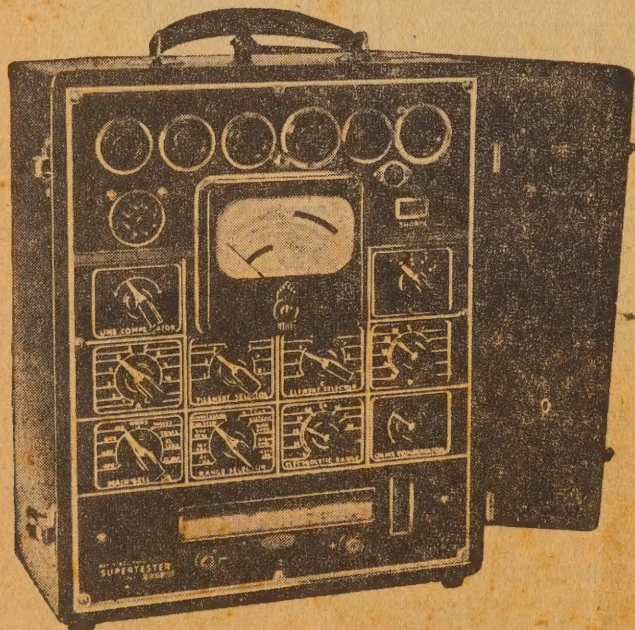
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Technical Review

NEW TRANSMITTER DIVERSITY SYSTEM MINIMISES FADING

Fading of radio signals has been a problem for the communications engineer since he first attempted to transmit radio messages over distances of 100 miles or more. It is required only a short time for research to reveal the Cause; the Remedy — even a partial one — is taking a great deal longer.

WHILE a complete mastery has not yet been reached, one of the most recent developments, a system called Transmitter Diversity, already has demonstrated its value in minimising the effects of fading in certain types of communications.

In the early 20's, when trans-oceanic radio-telegraphy was coming into its own as the fastest means of intercontinental communications, fading had to be taken in stride.

In the knowledge of its cause lay a paradox. Strangely enough, the same phenomenon which made long-distance radio possible was also the basic cause of fading signals, namely the so-called Kennelly-Heaviside layer.

This layer, a mass of ionised particles high in the atmosphere, is created by the action of the sun's rays upon molecules of gas in the air. The particles act like a huge mirror reflecting back to the earth the radio signals which have passed beyond the horizon and outward into space.

Without this "ethereal blanket" long-distance telegraphy, radio-telegraphy, broadcasting, and radiophoto would be undependable, if not impossible.

SELECTIVE FADING

Early research on fading disclosed that a transmitter signal which faded at one location was, at the same instant, at its maximum strength at another receiving point some distance away.

Further experiments revealed that it was possible to connect the outputs of two receivers, connected to spaced antennas, so that the stronger signal, or a combination of the two signals, could be selected at all times.

This method, called Receiver Diversity, has been in use for many years at the large radio centres operated by RCA Communications, Inc., at Riverhead, NY, Point Reyes, California, and many other locations.

From the foregoing description it is obvious that Receiver Diversity requires considerable space for the location of the two receiving antennas, thus limiting its use principally to fixed land stations. Reception by this method on planes, ships at sea, or at receiving points in congested areas, such as large cities, is impractical.

With this knowledge RCA engineers began work on Transmitter Diversity.

They reasoned that duplicate transmitters connected to spaced antennas in the same manner as the receivers in the earlier method would provide a single distant receiving point with a continuously usable signal, since it was extremely unlikely that both incoming signals would fade simultaneously.

To determine the soundness of this theory, RCA conducted tests from Bolinas, Calif., to Riverhead, NY, and later from Bolinas to receiving points in lower and midtown Manhattan. In each instance, results demonstrated the effectiveness of Transmitter Diversity, particularly in urban areas where man-made radio noise is at a high level.

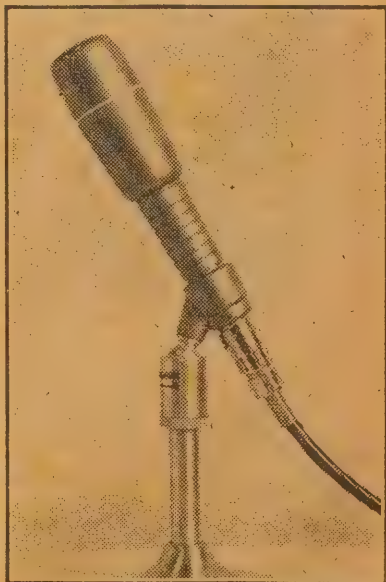
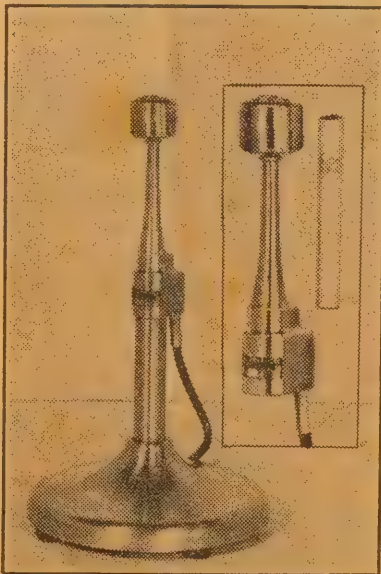
Transmitter Diversity, however, is

not expected to replace the established Receiver Diversity for most point-to-point circuits but it does offer a practical solution for certain types of important message services, including shore-to-ship, ground-to-plane, and fixed base to mobile vehicles.

From an economic standpoint, also, Transmitter Diversity has an advantage. It is less costly, for instance, to improve the reception of a signal at a single receiver by adding a second transmitter than to increase the power of the single transmitter to get the same results.

The power of the single transmitter would have to be increased from 16 to 1000 times that needed by each of the dual transmitters to give the same results at the receiver.

LATEST OVERSEAS MICROPHONES



Released recently by the Turner Company, the model 80X crystal, shown on the left (see insert) is not very much larger than a cigarette. Diameter of the top section is 1/8" and overall length is 4 1/2". Frequency range extends to 7000 cps. Model 51D, on the right, is a larger high-performance dynamic unit, with omnidirectional characteristics. It is available in a range of output impedance values and has a frequency range of from 60 to 13,000 cps.

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MODEL 47A-P MUTUAL CONDUCTANCE VALVE AND MULTITESTER



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MULTITESTER RANGES. 1000 ohms per volt A.C.-D.C.

D.C. Volts	D.C. Current	A.C. Volts	Resistance
0-120 m.V.	0-0.6 mA	0-1	0.5-22.5-1000 ohms.
0-3	0-6 mA	0-15	50-2250-100,000 ohms.
0-15	0-30 mA	0-150	x 500-22,500-1 megohm.
0-150	0-150 mA	0-300	x 5000-225,000-10 Megohms.
0-300	0-1.5 Amps	0-600	x with external battery.

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MODEL 75A

RANGES

20,000 ohms per volt A.C.—D.C.

D.C. Volts	A.C. Volts	A.C.-D.C. Current	Decibels	Resistance
0-0.1	0-1	0-50 uA	-30 to -5	1-50-10,000 ohms
0-2.5	0-2.5	0-5 mA	-22 to +3	1000-50,000-10 Megohms
0-10	0-10	0-50 mA	-10 to +15	*10,000-500,000-100 Megohms
0-50	0-50	0-500 mA	+4 to +29	
0-250	0-250	0-5 Amps	+15 to +43	*With external battery.
0-1000	0-1000		+30 to +55	

This is a robust 20,000 ohms per volt 50 range universal multimeter designed for accuracy and stability. Fitted into an attractive case, the meter is provided with instantaneous OVERLOAD PROTECTION. The clear, easy to read scale has a length of 4 inches. An internal buzzer is provided for quick continuity tests. Complete with test leads.



MODEL 120A POCKET MULTIMETER

RANGES

1000 ohms per volt A.C.—D.C.

D.C. Volts	D.C. mA	A.C. Volts	Resistance
0-0.25	0-1	0-10	0.5-20-2000 ohms
0-10	0-10	0-50	50-2000-200,000 ohms
0-50	0-50	0-250	*500-20,000-2 Megohms
0-250	0-500	0-500	*5000-200,000-20 Megohms
0-500		0-1000	
0-1000		0-2500	*With external battery.
0-2500			

This is an accurate pocket size instrument using a robust, sensitive meter movement fitted with instantaneous OVERLOAD PROTECTION and is housed in a high grade moulded case. All resistors used for voltage and current ranges are adjusted to an accuracy of 1%. Supplied complete with test leads.



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NEW DESIGN FOR BRITISH GOVT. HEARING AID

Several years ago, the British Medical Research Council produced a standardised hearing aid design as an adjunct to the National Health Scheme. New valve types and further research have now resulted in a modified design in which filament drain has been cut from 50 to 30 mA, and HT drain from 2.5 to 0.57 mA.

Fig. 1 is the revised circuit diagram.

High values of anode load in the early stages given gains of 30 for anode currents of 15 or 20 microamperes. Approximately 2 volts bias for the output stage is derived from a resistor in the common h.t. lead; the loss of gain due to feedback from this resistor does not amount to more than 2 or 3 db.

The switched capacitor C3 adjusts the top response to conform to either of the recommended standard frequency characteristics. Response curves of the amplifier alone are shown in Fig. 2.

The overall frequency characteristic is determined by the characteristics of the earpiece and microphone as well as by the intervalve and decoupling components and the output transformer.

The new insert earpiece is of the magnetic type with a single centre

Fig. 2. Frequency response curves of circuit of Fig. 1 for the two settings of the tone control switch.

Fig. 3. Limits of frequency response characteristic of insert magnetic ear-piece. At 750 c/s the level must not be less than plus 53db relative to 1 dyne/cm²/volt.

Fig. 1. (below) Circuit diagram of the "Med-reco" Mark IIA hearing aid for use with insert earpiece.

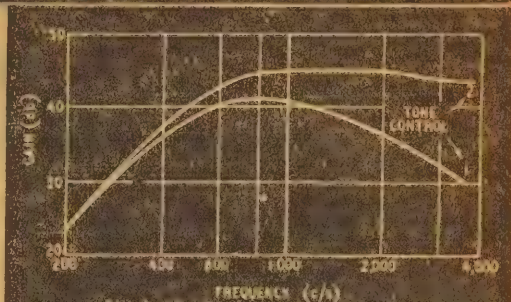


Fig. 2

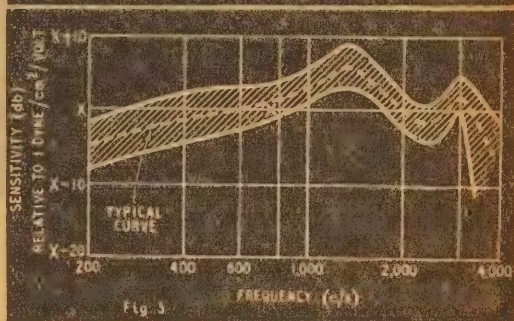


Fig. 3

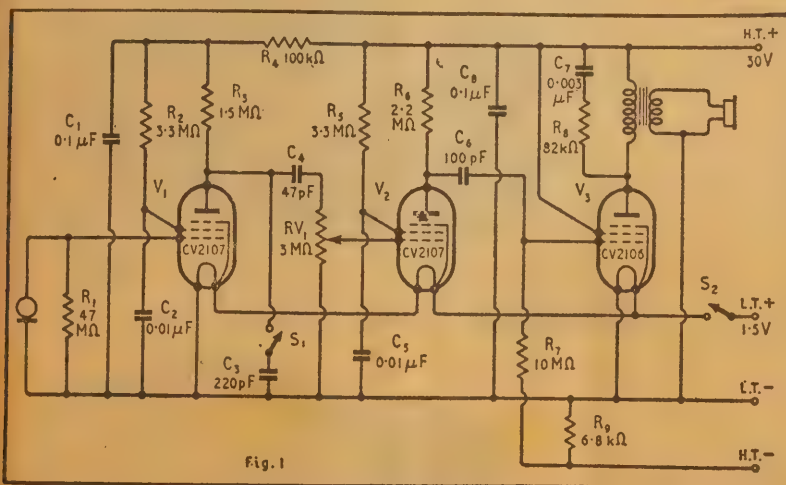


Fig. 1

peak-limiting methods for the benefit of people with nerve or perceptive deafness, who require a high sound level of limited range.

Developments in printed circuit techniques and crystal triodes are being followed as possible future solutions of the ever-present problems of reduced weight and costs of production and maintenance.

Twin Channel Sound

(Continued from Page 9)

period, then it is best that one of the microphones be pointed so that the principal speaker is near its axis, as in Fig. 2.

A rather specialised application of this technique is that used by police and Secret Service departments for secret recording of conversations.

Normally, if people do not wish their conversation recorded, they can mask the sound of their voices by making tapping noises, or by running water in a faucet. A monaural system cannot distinguish between the two sounds, and the recording is unintelligible.

Playback for an audience of the binaural recording requires two speakers. The placement of these speakers has been studied carefully by the Armour Research Foundation and others, and the best position for most applications in normal-sized rooms seems to be that of Fig. 3. With this placement the interference between speakers is least, while the area for good listening is largest.

The method of making binaural recordings of orchestras, choirs, and similar groups, depends to a great extent on the type of playback that will be used. If the recordings are going to be played back in homes and normal-sized rooms, the same techniques as described for conference recordings can be used.

Since this type of recording is often played for larger audiences, a dif-

(Continued on Page 19)

pole associated with a ring magnet. The diaphragm is unclamped and a dished steel front plate relieves the diaphragm of excess magnetic flux. Fig. 8 shows the average frequency response characteristic and the permissible limits.

All units are tested for sensitivity over the critical bands of 450-950, 1200-1700 and 2700-3200 c/s before acceptance.

As in the original hearing aid, a diaphragm-driven crystal microphone is employed and there are two types designed to match either the insert earpiece or the conventional external earphone which is supplied in special cases when the insert type cannot be used.

It is relatively easy to modify the frequency response of the microphone to fit that of the earpiece and amplifier, and the variables available for this purpose are the weight of diaphragm, size of crystal element, and the grade of silk covering in front of the diaphragm.

Although the basic layout of the amplifier is substantially similar to

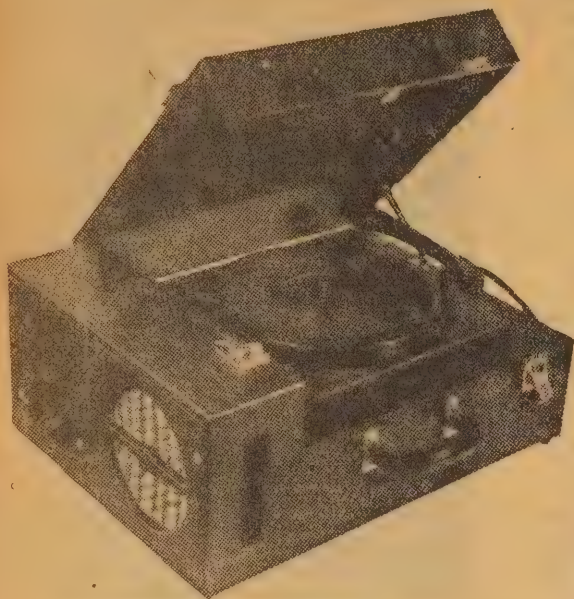
that of the original, detail changes have been made to reduce manufacturing costs and improve accessibility. A combined volume control and switch has been substituted for the original mechanically-coupled device.

It is reported that the p.v.c. — sheathed tinsel connectors have a service life of 6 to 12 months, and that improvements are being investigated to overcome failures due to migration of the plasticiser and discoloration by sweat acids.

Investigations of mercury, air-depolarised and re-chargeable batteries have been made, but it is considered that at present the Leclanche layer-type h.t. and "dolly" l.t. cells should continue to be used either for technical, economic or administrative reasons.

Fundamental research is continuing into the problems of the minority who do not benefit from the standard hearing aid. Field trials of a bone-conduction aid are being carried out, and clinical investigations are being made of automatic level control and

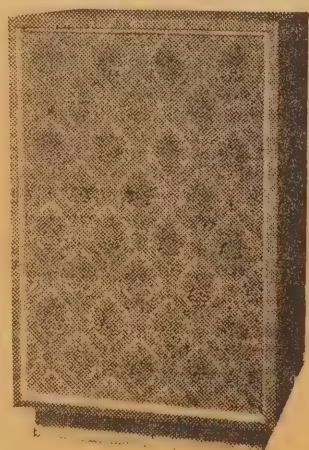
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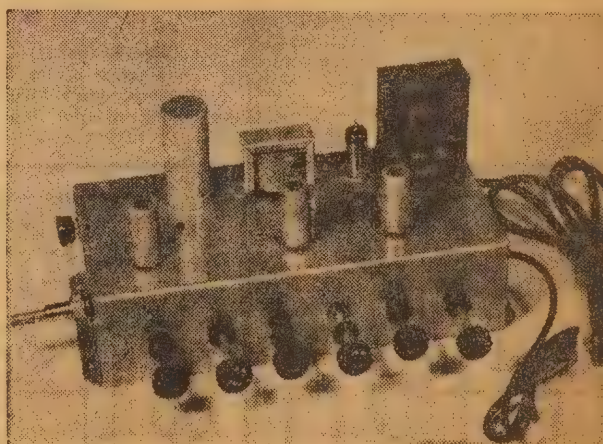
L. P. MICROGROOVE EQUIPMENT

Above: Model PG63

At left: Model PAG8

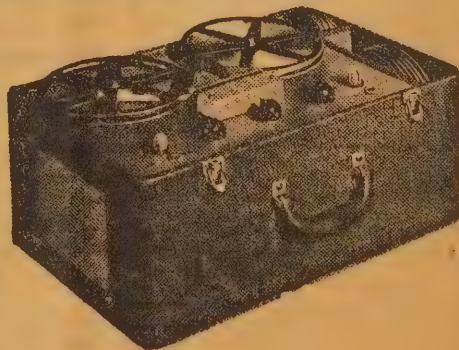


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AUTOMATIC BUOY KEEPS TAB ON WEATHER



The NBS floating-buoy automatic weather station, with antenna (front) and tail pipe (centre) detached from main assembly (rear). Powered by self-contained batteries, the unattended station will transmit coded weather reports by radio at 3-hour interval for 30 days. The cylindrical buoy (rear centre) houses most of the electronic equipment and weather-responsive elements, while the superstructure (rear right) supports the wind vane, and antenna-tuning housing, the transmitting antenna, and the anemometer (front right). An 8ft tail pipe (centre) with 40lb of lead ballast extends downward from the bottom of the cylinder.

A free-floating buoy-type weather station, developed by the US National Bureau of Standards for the Navy Bureau of Ships during World War II, reports weather data by radio automatically and unattended. The buoy incorporates various weather-responsive devices to switch a radio transmitter on and off at rates that can be translated by a receiving station into temperature, pressure and wind data.

INFORMATION is transmitted in a determined sequence at intervals of three hours. Self-contained batteries provide sufficient power for reliable operation at over-water distances up to 400 miles.

The station consists essentially of a timing mechanism, several weather-responsive devices, a relaxation or keying oscillator, and a simple two-stage radio transmitter. The weather-responsive devices cause associated resistors to vary with changes in weather conditions.

At three-hour intervals the timing mechanism, a modified automobile-type electric clock, turns the station on. While a program selector switch inserts one weather resistor after another into the keying-oscillator circuit in predetermined sequence a relay in the plate circuit of the keying oscillator switches the transmitter on and off at a rate proportional to the value of the particular resistor.

SIMPLE DESIGN

Most of the components are mechanically simple, and the electronic circuits are straightforward and conventional.

Twenty-seven feet in overall length and weighing 280lb, the station centres mechanically around a buoy cylinder 5ft long and 16in in diameter. Fastened to the bottom of the cylinder is an 8ft tail pipe ending in 40lb of lead ballast. On top of the buoy cylinder is a 7ft superstructure, above which an antenna extends another 7ft.

At the junction of the antenna and the superstructure is an antenna tuning house, while an anemometer is supported at the top of the antenna. Housed in the buoy cylinder are the rest of the electronic components and weather-responsive elements, as well as the batteries.

Each transmission lasts about 10 minutes. First comes an "attention" signal, consisting of a series of rapid pulses easily recognisable by the listening station operator.

Transmitted next is a "reference"

signal; this will be of constant pulse rate in the absence of transmitter damage or aging, and any variation in pulse rate indicates a need for calibration corrections of the other signals. An "identification" signal follows, the rate of which is characteristic of the particular weather station.

The various meteorological signals are next transmitted. With completion of the program the selector switch disconnects all elements and turns off the transmitter.

Five meteorological variables are reported by the standard model of the weather station: air temperature, water temperature, air pressure, wind speed, and wind direction. Five different devices, in combination with the relaxation oscillator, key the transmitter at rates corresponding to each of these variables.

The air-temperature and water-temperature elements each consist of a temperature-responsive ceramic resistor. Mounted inside the buoy cylinder, the water temperature element attains the temperature of the water because of conduction through the cylinder walls. The air temperature element, at the bottom of the

antenna tuning house, is protected by a louvered shield.

The barometric unit, of the aneroid type, is located inside the buoy cylinder. Prior to transmission of the pressure signal the indicating arm moves freely over, but not in contact with, 50 contacts connected to resistors. A clamping magnet, energised during transmission of the pressure signal, holds the barometer indicating arm against the contact over which it has located itself.

The air-speed indicating mechanism differs from the others in that no variation of resistance is involved. Instead, an electrical contact is made with every revolution of the anemometer, and this contact keys the transmitter directly.

WIND DIRECTION

The wind direction indication from the free-floating buoy, initially a perplexing problem, was accomplished by letting the whole buoy serve as a highly damped weather vane.

While a rudder on the buoy superstructure keeps the buoy oriented in the direction of the wind a direction indication is given by a modified aircraft-type magnetic compass inside the buoy. Immediately above the master compass needle, which is sealed in liquid, a slave needle rotates over 36 resistor-connected contacts mounted at 10-degree intervals.

During transmission of wind direction a clamping solenoid holds the slave needle against the contact toward which it is pointed.

Twin Channel Sound

(Continued from Page 17).

ferent technique may be used. Instead of simulating a listener's ears with two microphones, they are placed as shown in Fig. 4. A soloist should be placed near one of the microphones as shown in Fig. 4, to give more pleasing results. Speakers would then be placed as shown in Fig. 5, for a large auditorium.

The uses of binaural system in industry are great in variety. The equipment can either be used in its true binaural sense, or the two channels can be used to record separate sounds simultaneously. Magnetic recording has long been used to help in the analysis of vibration and noise.

With a binaural system, a tape recording will not only record noise, but the position in which it originates.

When the two channels are used separately, one channel can be used to record the noise or sound under test, the other channel can be used to record a time signal or a voice commentary, describing the test. Sometimes it is important to record input and output functions simultaneously, and the binaural equipment can be used for such recordings.

A typical installation of Magnetic recording equipment is used by an American automobile manufacturer for binaural recording of automobile noises.

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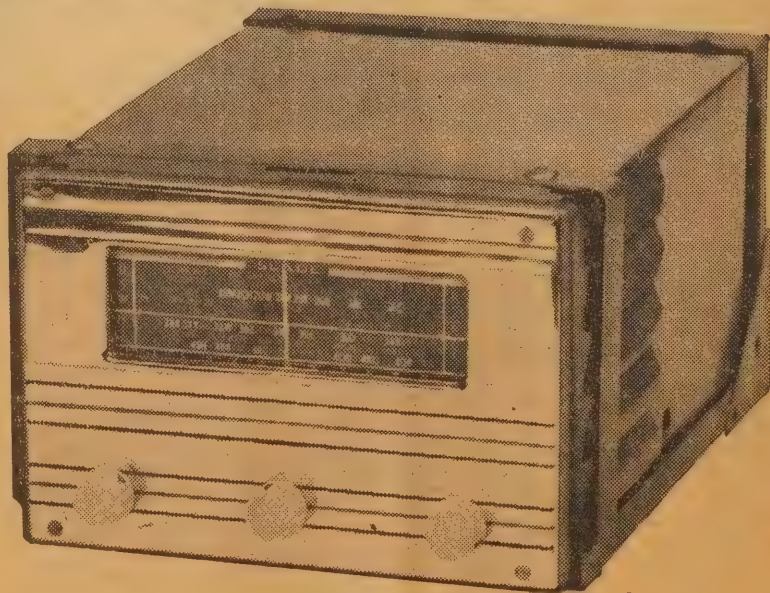
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NEWS AND VIEWS OF THE MONTH

Scientists gather

TO Dr. D. F. Martyn goes the credit for bringing a host of world-ranking scientists to Australia this month. They are attending the tenth assembly of the Union Radio-Scientific Internationale—abbreviated URSI.

Dr. Martyn, head of the Australian Radio Research Board, was present at the last General Assembly of URSI (of which he is vice-president), held in Zurich. In view of the outstanding work on radio-astronomy accomplished in Australia, Dr. Martyn persuaded the Assembly to hold its meeting this year in Australia so that visitors could observe this work at first hand, and meet the team responsible for it.

Its members are Dr. J. L. Pawsey (leader), W. N. Christiansen, Frank Kerr, Bernard Mills, Ruby Payne-Scott, Alec Shain, and Paul Wild.

URSI is one of the ten International Scientific Unions supported by adhering countries and UNESCO. It meets every two years, and is concerned with fundamental research in radio, and not the engineering side of it. Hence its interest in the ionosphere which contributes so largely to the problems of radio propagation, Radio Propagation itself, the sun, its spots, flares and other phenomena, and Radio Astronomy, which detected bodies in outer space by their radio waves as against light waves. The Australian research team has detected large numbers of these "radio stars."

The meetings will be held at the Sydney University, and the Assembly has been assisted financially by the Commonwealth Government.

President of URSI is world-famous scientist Sir Edward Appleton, whose work on the ionosphere resulted in the Appleton Laver being named after him. Mr. Hanbury Brown, of the Jodrell Bank Experimental Station, is another visitor, one of the original team of radar scientists who worked with Sir Robert Watson Watt.

Dr. Bath van der Pol will also be present, who, it will be remembered, visited Australia in 1937 during the Convention of the Institution of Radio Engineers. Altogether some 60 scientists are expected to be present from many countries in Europe and America.

The Assembly should prove a great encouragement to Australian research workers, and do much to bring their achievements to date before the scientific eyes of the world.

* * *

Taxis in space

TAXI rocket-ships, shaped like dumb-bells, will one day shuttle citizens between cities floating in space and enclosed in transparent wrappings.

This is the view of the future held by Arthur C. Clarke, chairman of the British Interplanetary Society, now on a lecture tour of the US.

Clarke said that if technical progress continued at the pace of the past century, our descendants of a century to come might take for granted:

- Man-made satellites built 24,000 miles above the earth, spinning endlessly about the planet and providing ideal relay points for television transmission.

- Atomic - powered rocket-ships carrying passengers and cargo from earth to space stations, where they would be transferred to dumb-bell-shaped shuttle rockets designed to travel between heavenly bodies without even landing.

- Other rockets designed to land on moons and planets with very slight gravitational pull.

- Whole cities erected on lifeless worlds and made habitable by enclosing them in immense, weightless, cellophane-like wrappers that will maintain the earth's atmosphere inside.

Humans would pass in and out of such cities through airlocks designed to keep "thin" air out.

* * *

Rocket defence

THE authorities will build a ring of rocket defences to protect Britain as a result of information gained from tests at the Woomera range in Australia.

Rocket weapons will eventually replace existing artillery posts.

They will be able to maintain so sustained and accurate a barrage that an enemy would have only the minimum chance of getting through.

The Empire News says contracts have already been placed with the Fairey Aviation Company, which has opened headquarters in Sydney for manufacturing test rockets in Australia.

* * *

Unit radio

THE practice of buying high quality radio-equipment on the unit system seems firmly established in both England and America.

POPULAR SCIENCE QUIZ

Q. What is the Nautical Almanac?

A. It is an almanac prepared specially for navigators and astronomers, with tables showing the daily positions of all the bodies of the solar system, the places of the fixed stars, predictions of forthcoming astronomical events and other similar information.

Nautical almanacs are issued by most maritime nations. One of the most famous is the British Nautical Almanac, first prepared in 1767 by the Astronomer Royal, Dr. Maskelyne, and published with the authority of the Government. After Dr. Maskelyne's death the almanac was still issued but it became less accurate and efficient until it was necessary to completely re-organise it. The first of the new series was issued in 1834 by the Admiralty who have been responsible for it ever since. It is issued four years in advance of the year to which it refers.

* * *

Q. Why does glue hold wood together?

A. Glue is one of the substances which, when heated, change their

form gradually from the solid to the liquid, as opposed to the instantaneous change in ice melting to water. It is referred to as being viscous, that is, an imperfect fluid only.

When the surface of a piece of wood is smeared with glue in the semi-liquid state and another piece of wood placed on top, the glue is forced into the hollow air spaces of the wood and, as soon as the glue cools and hardens, it is firmly anchored in each piece of wood, the adhesion of the molecules holding the whole structure together.

The glue does not penetrate the cell walls of the wood but merely enters the exposed openings of the cell cavities. When a section is cut through two pieces of wood glued together and examined under the microscope, it will be seen that the glue has filled the exposed pores of both pieces of timber.

Obviously the more cavities there are in a piece of wood, and the larger the cavities are, the more successfully it can be glued.

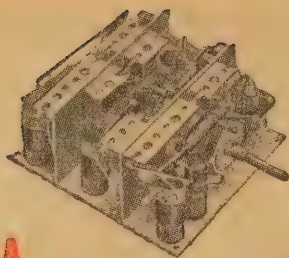
Thus bass-wood can be glued more easily than oak.

* * *

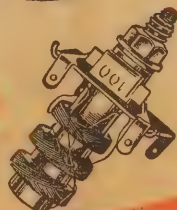
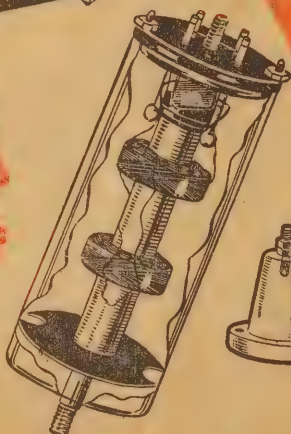
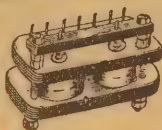
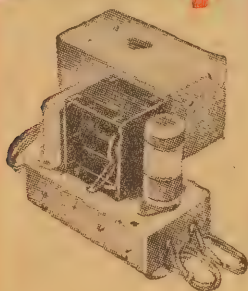
Q. How did the Romans measure distance?

A. The Roman mile consisted of 1000 double paces, or "mille passuum," as they called it. However, the Roman word "passus" referred to the distance between the point the foot left the ground and the point where the same foot came down in marching, or about 5ft. The Roman mile was thus considerably shorter than the present English mile—about 1620 yards as compared with 1760 yards.

In the course of researches into the subject, an Italian archaeologist named Luigi Canina, who lived from 1795 to 1856, measured very carefully the Antonine and Trojan columns in Rome and found them to be, exclusive of their pedestals, exactly 100 Roman feet in height. Using this distance as a measuring length, he found that for 12 miles down the famous Appian Way measurements tallied with the traditional sites of the old Roman milestones along the road.



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England has been selling tuner control, and amplifier units for some time. In the USA, the practice, as mentioned elsewhere, seems to be reaching considerable proportions.

One firm has a number of these units, of various complexity and price, arranged on the "plug-in" system.

A customer may hear the effect of any combination. According to his requirements and the depth of his pocket, he picks the combination which suits him best, and takes it away under his arm (more or less).

The customer fixes his own cabinet arrangement and speaker mounting being assisted by suggestions from the firm which sold him the gear.

Some of the bigger companies are exploring this field. Stromberg Carlson will sell on this unit plan, with special TV chains, FM and AM tuners, a 10 and 25 watt high-grade amplifier, and special speakers ready mounted in acoustic labyrinths.

This kind of business looks to have a bright future if properly handled. And as amplifier fans are notorious for chopping and changing, why not a trade-in section as well? After all, amplifiers don't deteriorate so very quickly, and there is a limit to one's outlay at any particular time.

Radar in war

THE latest type of interceptor-fighter announced in America is one step nearer to the completely automatic aircraft. It has a mass of radar gear fitted in the nose to take over control when the pilot's reactions would be too slow.

During the last war, considerable progress was made in radar operated control devices, particularly as applied to gunnery.

By a process known as "Automatic Follow" a gun turret was developed which automatically trained the guns on the nearest target. They followed this target until it was shot down, or passed out of range. When this happened, the guns picked up the next nearest target and the process was repeated.

The great speed of the latest jet interceptors is such that human reaction is too slow in keeping the aircraft on the target. When he approaches it in this latest machine, the pilot hands over to the automatic control.

Not until the interception is complete does the pilot take over again, and fly the aircraft home.

A deadly companion in destruction now in use is the radio controlled projectile which was recently seen in action on local newsreels.

Once released, the projectile is fully under radio control from the aircraft until it hits the target.

These are only two examples of the achievements made and so far disclosed in the field of automatic weapons. It is safe to assume that much more spectacular devices are under way and still on the secret list.

The use of pulse technique to obtain information from targets is capable of almost endless applications and can be controlled with a remarkable degree of accuracy. Radar was rightly considered to have revolutionised warfare during the last war, and at its conclusion there was scarcely an operation which did not rely upon radar for vital information.



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FEATURES

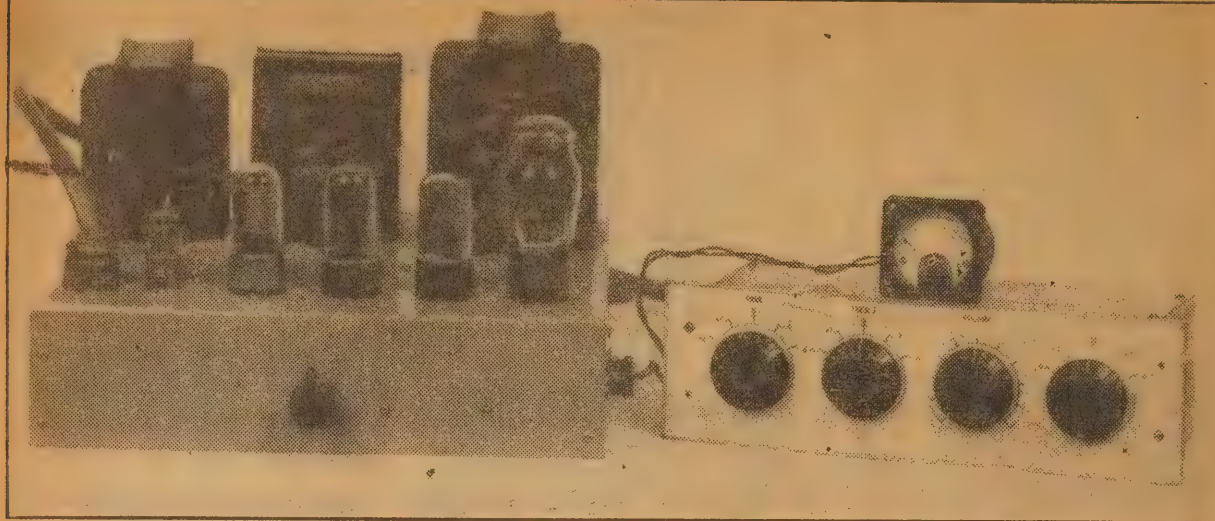
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The complete equipment, comprising a Playmaster No. 2 amplifier, No. 2 control head and a 2" one-milliamp meter for level indication. The tuner on page 48 would mate ideally with this equipment.

RECORDING WITH A PLAYMASTER

For some time we have planned to describe a more elaborate disc recording circuit than the Junior Recorder described in *Radio and Hobbies* for April 1951. This article shows how the Playmaster amplifier equipment can be adapted for the purpose with even better results.

THE Junior Recorder, which has been built by quite a few of our readers, has proved capable of all that was claimed for it, and has been in constant use ever since it was built. It has made many splendid records, and has in addition drawn much complimentary comment from all who have heard it as a radio receiver and a radiogram. For general use, it still remains a particularly useful, simple, and effective circuit.

It might be as well briefly to describe this equipment, in case you are not immediately familiar with it.

ORIGINAL RECORDER

It was designed primarily as a simple, wide-range radiogram, including facilities for recording on disc from radio, records, or microphone. As such, it posed a number of problems.

In the first instance, it was necessary to adopt a wide-range tuner circuit—one which would separate the local stations and at the same time avoid any more side-band cutting—high-note loss to you!—than was practicable. At that time, there was no real alternative to a TRF circuit which, although not ideal, was a big improvement on the conventional superhet. The tuning coils were loaded with resistors to widen the response "skirt" of the tuner until we could just separate the locals. It was argued that, for wide-range results, only local stations were of any use, and we didn't therefore miss the sensitivity loss which this process brought about.

We were immediately plagued by the inter-carrier heterodynes which are unavoidable with any wide band

tuner. These are heard on some stations as an irritating whistle, the pitch of which hits 10 Kc. They are caused by interaction between the local station's carrier, and that of another station—generally much weaker—which occupies the next channel spaced 10 Kc away. Sometimes the whistles are very strong, but even when they are weak, they completely spoil reception, particularly if the loud speaker is a wide-range type.

by
John Moyle

To cut a long story short, a whistle filter was devised tuned exactly to 10 Kc. and included in the circuit so that it absorbed a narrow band of frequencies above and below the whistle.

This filter circuit has been included in all our wide-range tuners of recent times, and has proved a most effective "whistle-wiper." There's only one minor snag—it must work in a low impedance circuit which we obtained by a cathode follower coupling into the audio stages.

This was the radio side of the Junior Recorder. The audio amplifier was a two-stage job using a 6AQ5 output valve and a 6AU6 driver with a large amount of negative feedback. One switch selected the radio, pick-up or microphone. Another

gave (1) normal speaker connection, (2) recording with the speaker as a monitor with reduced volume and (3) recording without the speaker.

The circuit also provided for a variation in the inverse feedback loop to give some degree of automatic matching to the high-impedance recording head—one of the most important methods of getting the best frequency response from it. The same general scheme is used in the amplifier to be described here, and we will cover it later on in this article.

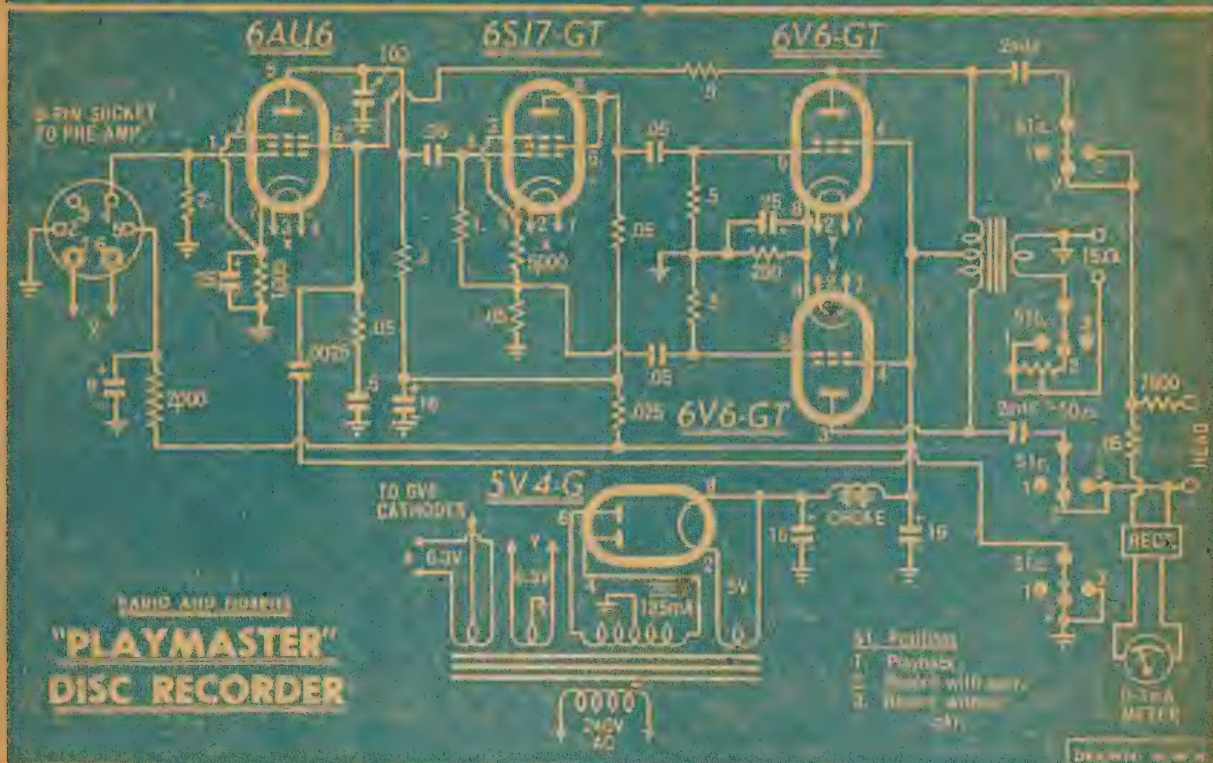
The recorder was intended for use with a high impedance recording head—actually a Byer R-12-D which is possibly the only type available through almost any radio dealer.

MORE AMBITIOUS

Now while it is doubtful whether one could greatly improve on the Junior Recorder as such, it has limitations which a "Senior" could remedy at the cost of extra complication and outlay. The most important of these is the inability to record with a high degree of high frequency pre-emphasis such as we find, for instance, in modern microgrooves. This pre-emphasis involves recording the high frequencies at a boosted level, and playing back the record with an equivalent amount of high frequency de-emphasis, or just plain high-note "cut." As you probably know, this is a powerful weapon against record surface noise, which is reduced in direct proportion to the amount of top cut used during playback.

To use pre-emphasis, we obviously must use an amplifier capable of producing without distortion a much higher than normal high note re-

PLAYMASTER No. 2 MODIFIED FOR RECORDING



Chief difference between this and the Playmaster No. 2 circuit is the use of screen circuit instead of voice coil feedback. The feedback is rendered partially inoperative for recording. Feedback on playback is about 20db.

sponse. This means a more powerful type than that of the Junior Recorder, but of course it also means more valves and bigger power supply.

A Senior Recorder is also required to provide some extra flexibility in the way of bass and treble boost and cut, not only to reduce the danger of overcutting on heavy bass notes but to reinforce this region if required during playback. The treble control is necessary, too, to provide pre-emphasis if the recording material demands it, and a corresponding extra cut for the same reason.

At this point I think we can introduce the Playmaster equipment as possessing the necessary features for a bigger and better recorder.

ADDITIONAL CONTROL

In the Control Unit No. 2 we have these extra bass and treble controls, as well as automatic compensation for all types of records, plus a radio and microphone selector switch.

We also have a push-pull 6V6-GT amplifier with a 10-watt output—just about right for looking after the power position. And, of course, we have a series of tuners for it, some of which measure up quite well to the requirements for making good recordings of radio programs.

The best of these looks to be the tuner described in this issue. It has special features which make it almost ideal as a wide-range tuner, complete with whistle filter and a much better response curve than we get from the TRF tuner of the Junior. The full story of this tuner is told in the appropriate article, so we will not repeat it here. At the same time, the TRF tuner is a perfectly good substitute in its own way.

In this article we intend to set out some experiments made with the 6V6 Playmaster adapted for recording, used with No. 2 Control Unit and suitable tuner. At a later date we may describe the whole circuit combined into one unit, but it will, of course, operate just as well in the present three-unit form.

Let us now consider the problem of feeding the amplifier output into the recording head and how it has been tackled in the amplifier.

FEEDING THE HEAD

The head itself has a nominal impedance of 4000 ohms at 1 kc, which would be fine if it stayed that way. But being actuated by a coil, its impedance rises rapidly with frequency, and at 10 kc it is high enough to run right off the graph paper, as the published curve shows. If we are to avoid a serious and sharp attenuation in performance at these higher frequencies we must do something about keeping them somewhere near the level at 1 kc.

The job is made all the harder because the cutting head has a natural resonance around about the 4 kc mark, just as would any heavily-damped and rugged pick-up of the old days, and to which it bears considerable physical resemblance.

We can make up our minds from the start that we won't be able to match a commercial micro-groove with our home recorder-type head. The best we can expect is a reasonably flat response up to about 7 or 8 kc, not too much of a bump in the middle register, and a bass roll-off from about 1 kc, something like the normal recording curve. Fortunately it's not too hard to get quite a good

bass characteristic capable of convincing results.

At this point it would be wise to talk about the inverse feedback circuit, because it is not the same as used in the Playmaster, and the difference is quite important to the story.

SPEAKER CIRCUIT

One of our requirements is to record with the speaker monitoring at reduced level and another is to record without the speaker at all to avoid microphone feedback. But there isn't any easy way we could find of doing this without switching in the voice-coil circuit. The original circuit used feedback taken from the voice-coil circuit, and any variation in this circuit will upset the feedback characteristic, giving a different degree of gain in each position.

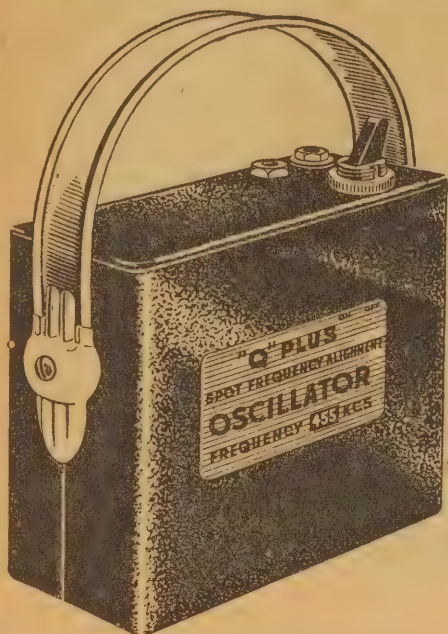
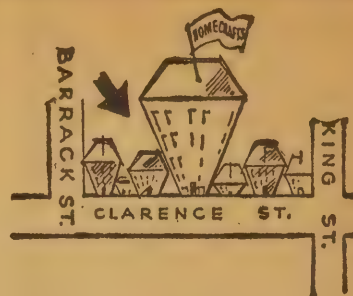
It was therefore necessary to abandon the voice coil feedback and use instead the well-known circuit which couples from one output plate into the screen of the 6AU6 voltage amplifier. This is quite a good circuit, although it does require a good output transformer, the deficiencies of which are no longer compensated by the feedback network. It also throws more stress on power supply filtering, as the 6AU6 screen circuit cannot be decoupled. It is, however, a very stable, and foolproof circuit and should be considered only one degree less preferable than the original.

Its use allows us to perform a very simple switching operation in the voice coil circuit to provide a series resistor to cut down the output while monitoring and to avoid wasting power which should be diverted to the cutting head. The switch to "no

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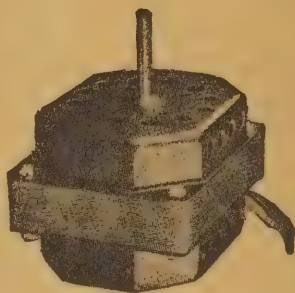
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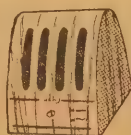
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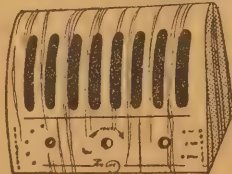
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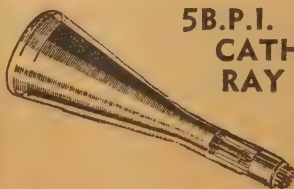
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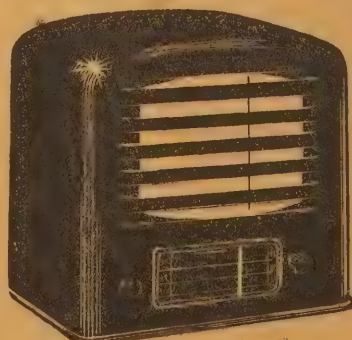
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FEEDBACK FACTOR

Now, as you will know, the application of feedback to pentodes or beam tubes reduces their effective output impedance quite drastically, so that it approaches that of triodes. Without feedback the output impedance is very high. But you'll remember that the impedance of the cutting head also rises to a very high value at these higher frequencies and that we are looking for a circuit which will provide some automatic matching for it.

SERIES RESISTOR

At higher frequencies, however, the impedance of the cutting head will rise, as we have shown in the graph. Soon it will equal that of the resistor. At still higher frequencies the impedance of the head will far exceed that of the fixed resistor and the major portion of the output voltage will appear across the cutting head. At, say, 50,000 ohms impedance, which might be reached by the head, the 7500 ohms resistor may just as well not be there. Its presence does help in keeping the current through the head at a constant value, remembering that the head is a current-operated device.



As will be seen from the circuit, the head is fed from the plates of the output valves through a pair of 2 mfd. blocking condensers. Here, of course, larger values would lift the bass, and smaller values would decrease it, after the manner of coupling condensers. But if we remember that we have in fact a pair of capacitors in series with an inductance (the

The main purpose of the series resistor is to help reduce the size of the hump. This it does by reducing the "Q" of the tuned circuit, which can be done by introducing resistance in series (or parallel) with it. The



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10	5000, 2500 SE	12.5, 8, 2.3	69/10		OP-1
10	5000, 2500 SE	5, 2.7	71/-		OP-33
10	5500 SE	3.9	78/4		OP-41
10	30,000 20,000 14,000 10,000 7000, 5000, 2500 PP	2.3	70/10	Universal Test Loud Speaker	OP-53
10	5000, 2500 SE	15, 12.5, 8.4, 6.5, 4, 3, 2.7, 2.3, 2.	78/4		OP-54
10	5000, 2500 SE	15.	71/-		OP-39
10	10,000 PP	15, 8.4, 2.3.	78/4	5W Cath Amplifier	OP-85
10	7000 PP	Any ONE of following impedances—15, 12.5, 8.4, 2.3, 2.	78/4	9W Cath Amplifier	OP-92
15	5000 PP	12.5, 8, 2.3.	107/8		OP-2
15	6600 PP	12.5, 8, 2.3.	107/8		OP-3
15	10,000 PP	12.5, 8, 2.3.	107/8		OP-4
15	10,000, 6600, 5000 PP	12.5, 8, 2.3.	107/8		OP-5
15	5000 PP	15, 12.5, 8.4, 6.5, 4, 3, 2.7, 2.3, 2.	114/9		OP-55
15	6600 PP	15, 12.5, 8.4, 6.5, 4, 3, 2.7, 2.3, 2.	114/9		OP-56
15	10,000 PP	15, 12.5, 8.4, 6.5, 4, 3, 2.7, 2.3, 2.	114/9		OP-57
15	10,000, 6600, 5000 PP	15, 12.5, 8.4, 6.5, 4, 3, 2.7, 2.3, 2.	116/-		OP-58
25	10,000, 6600, 5000 PP	15, 12.5, 8.4, 6.5, 4, 3, 2.7, 2.3, 2.	145/5		OP-59
32	10,000, 6600, 5000 PP	15, 12.5, 8.4, 6.5, 4, 3, 2.7, 2.3, 2.	185/10		OP-60
60	3800 PP	17.6	181/2		OP-36
60	3800 PP	100, 75, 50, 25, 10, 5, 2.	212/5		OP-61

P.A. RANGE 50-8000 cps. Output to Line

10	5000, 2500 SE	500	69/10		OPIA
10	5000, 2500 SE	500, 250, 125	80/9		OP-44
15	5000 PP	500, 250, 125	107/8		OP-6
15	6600 PP	500, 250, 125	107/8		OP-7
15	1000 PP	500, 250, 125	107/8		OP-8
15	10,000 PP	500, 250, 160, 125, 100, 83.5, 71.5, 62.5, 55.5, 50	127/6		OP-8M
15	10,000, 6600, 5000 PP	500, 250, 125	107/8		OP-9
15	5000 PP	600, 300, 200, 150, 130, 100, 75, 50	124/11		OP-34
15	8000 PP	600, 300, 120, 60, 30	217/3		OP-50
25	5000 PP	500, 250, 125	130/-		OP-10
25	6600 PP	500, 250, 125	130/-		OP-11
25	10,000 PP	500, 250, 125	130/-		OP-12

Wts	Primary Impedance	Secondary Impedance	Retail Price	Special Application	Code No.
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P.A. RANGE Cont.

25	10,000, 6600, 5000 PP	500, 250, 125	130/-		OP-13
25	10,000 6600 PP	500, 4000, 8.4, 2.2	178/4	Cutting and Playback Amplifier	OP-35
25	6600 PP	600, 300, 250, 200, 170, 150, 75, 50, 36, 27, 12.5, 7.5, 6.2, 5	217/3		OP-38
32	5000 PP	500, 250, 125	157/6		OP-14
32	6600 PP	500, 250, 125	157/6		OP-15
32	6600 PP	500, 250, 166, 125, 100, 83, 5, 71.5, 62.5, 55.5, 50	161/8		OP-15M
32	10,000 PP	500, 250, 125	157/6		OP-16
32	10,000, 6600, 5000 PP	500, 250, 125	157/6		OP-17
32	6600 PP	140, 70	185/10		OP-48
60	3800 PP	500, 250, 125	183/4		OP-18
60	3800 PP	100, 75, 50, 10, 5, 2	212/5		OP-61
80	6400 PP	500, 250, 125	225/-		OP-37
105	8800, 6000 PP	500	325/-		OP-49
150	11,600 8400 PP	500, 250, 166, 125	417/6		OP-20

HI-FI RANGE 30-15000 cps. Output to Voice Coil

5	5000 SE	Any ONE of the fol- lowing impedances 15, 12.5, 8.4, 6.5, 2.1	73/4	4W Baby Playmaster	OP-24
10	3250 SE	12.5, 8.4, 2.3	110/-	R & H Vox Major	OP-23
10	5000 SE	2	100/-	For Rola 120x Speaker	OP-113
10	5000 PP	2	100/-	For Rola 120x Speaker	OP-117
10	6600 PP	2	100/-	For Rola 120x Speaker	OP-119
10	8000 PP	2	100/-	For Rola 120x Speaker	OP-118
10	10,000 PP	2	100/-	For Rola 120x Speaker	OP-112
15	5000 PP	12.5, 8, 2.3	160/-		OP-19A
15	10,000 PP	15, 3.75	166/3	10W Playmaster	OP-63
15	10,000 PP	12.5, 3.125	166/3		OP-64
15	10,000 PP	8.4, 2.1	166/3		OP-65
20	4500 PP	15.5, 12.5, 8.6, 2.7, 2	146/-	15 & 32W Cathamplifiers	OP-51

Output to line

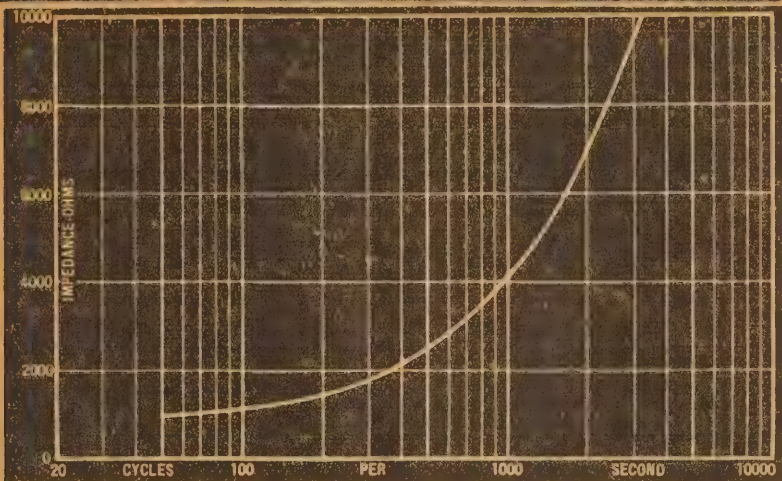
10	3250 SE	500, 250, 125	110/-		OP-22
15	5000 PP	500, 250, 125	160/-		OP-19B
15	10,000 PP	500, 125	166/3		OP-62

SPECIAL HI-FI RANGE 20-30,000 cps.

15	10,000 PP	8.4, 2.1	196/8	For Williamson Amp.	OP25/8.4
15	10,000 PP	10, 2.5	196/8	For Williamson Amp.	OP25/10
15	10,000 PP	12, 3	196/8	For Williamson Amp.	OP25/12
15	10,000 PP	15, 3.75	196/8	For Williamson Amp.	OP25/15
15	10,000 PP	16, 4	196/8	For Williamson Amp.	OP25/16
15	10,000 PP	40, 10	196/8	For Williamson Amp.	OP25/40
15	10,000 PP	250, 62.5	196/8	For Williamson Amp.	OP25/250
15	10,000 PP	500, 125	196/8	For Williamson Amp.	OP25/500
15	5000 PP	8.4, 2.1	209/2		OP-66
15	5000 PP	15, 3.75	209/2		OP-67

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IMPEDANCE-FREQUENCY CURVE



The impedance-frequency curve of the Byer recording head type R-12D. The curve is typical of high impedance magnetic heads.

larger the resistor, the greater the reduction of the hump. The main limit is set by the available power output, which determines how much we can afford to waste in the resistor.

By this time you will have realised that, remembering that each cutting head will have its own characteristics (plus or minus some optimum design figure), a fair bit of experiment with an audio oscillator, oscilloscope, and some test discs will be required to shape the final response of the system for the nearest approach to the ideal. In practice, this procedure isn't strictly necessary, although desirable. We freely admit that to date the values selected for this recorder have been decided mainly on listening tests, using a good speaker and a pretty flat pick-up, plus a good deal of general experience with what can be expected from the equipment.

LISTENING TESTS

The values shown allow us to record microgroove discs from radio with extra treble boost, and to play them back with the selector in the standard microgroove position—that is with appropriate bass boost and treble cut. Some records can stand a little more bass boost, and some a little more treble cut, depending on the music and the amount of surface noise on the disc.

At least 15 minutes of clean, bright recording can be had on a twelve inch disc. In this regard results are much better than with the Junior, which was without the benefit of the extra high-frequency flexibility. The discs, too, appear to take the pre-emphasis without distress or distortion. We can now use a degree of radius correction, which compensates for the falling off at the top end near the centre of the disc. Up to 20 minutes can be recorded at a pinch without too much loss during the first inch.

You might query whether all these goings on are responsible for a higher degree of distortion at the top end than at the 1 Kc reference. There's no doubt that they are. But the cutting head, with a useful limit of about 8 Kc, and a rapid attenuation after that, isn't able to reproduce it. If we were attempting to compete with a commercial microgroove recording up to 15 Kc we might think twice before playing about with the

feedback, for instance. We are lucky that a home recorder isn't as demanding and yet can sound so good.

When recording from microphone, a crystal type such as the MIC 19 is recommended. It will do well with the ordinary conversational level at a couple of feet or so, and a piano records well with the mike close to the instrument.

HUM PROBLEM

Because of the very high input impedance of the microphone and the high gain of the channel some hum might be evident if you try to work too far away from it. This appears to be due mainly to the amount of unshielded wiring which connects to the input grid and to the metal work of the input selector switch. It doesn't matter much with the lower gain and lower impedance when using a pickup, but the microphone position is a very different story.

You can assist matters by taking care with the placement of leads, particularly to keep the grid wiring away from the heater circuit. You will find, too, that an earth on the amplifier chassis will help.

If serious microphone work is contemplated, it would be better to provide a separate voltage amplifier for the microphone, but this would depart from the standard control circuit, and in the average case would be scarcely justified. Serious recording, involving high gain microphone settings really calls for special precautions against hum.

LEVEL INDICATOR

The volume level indicator is a one milliammeter and rectifier fed through a suitable series resistor to give an average reading of not more than about one-third scale. This will normally be something around 50,000 ohms. It will vary from head to head, as some heads take a little more driving than do others. A regular meter rectifier can be used or, at a pinch, one of the small full-wave types available from disposals.

One switch does all the necessary circuit changing for recording and playback. The switching from radio to pick-up or microphone is carried out in the control unit. For playback all the recording circuitry is

(Continued on Page 90)

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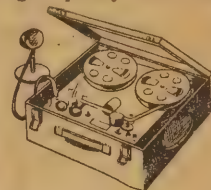
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A COURSE IN TELEVISION

PART 39—SYSTEMS OF COLOR PRESENTATION

Having examined in detail the physics of color itself, it is a simple matter to assimilate the principles of a complete color TV system. This present instalment, based on an "Aerovox" paper explains the operation of field, line and dot-sequential systems.

ALL systems which have been seriously considered for color TV are trichromatic in nature, i.e., three primary colors are used in various combinations to form all the hues of the visible spectrum.

The primary colors employed are not the familiar red-blue-yellow used in art and color printing, but rather a more basic red-green-blue combination. These primaries are known as the "additive" primaries whereas the red-blue-yellow primaries (more accurately "magenta-cyan and lemon-yellow" since they are complex colors made up of bluish red, bluish green and greenish yellow, respectively) are known as the "subtractive" primaries.

The distinction comes from the fact that a subtractive color filter subtracts one color from pure white

terval which is shorter than the persistence of vision of the human eye (about 1/16th of a second) the eye sees the "secondary" color formed by those primaries.

Thus, a yellow object is produced by transmitting its image in both red and green, in rapid succession. The various tones or shades of yellow are formed by varying the relative intensities of the two primaries forming it.

In the same manner all other colors are produced by transmitting their primary color values in sequence.

This method, which is common to all systems practical for broadcast use, is therefore called the "sequential" system of color transmission. The various systems using it differ essentially only in regard to the rapidity with which the color values

of the composite color picture are sequentially "sampled."

The elements of a field sequential system, which is the simplest in all respects, are shown in Fig. 2. In this system, the colors are switched after the transmission of each field.

A rotating color wheel placed in front of the camera tube causes the scene being televised to be passed through a different additive primary color filter during the scanning of each field. Thus, one field contains information on only the red elements of the picture, the next field only the blue and the next field green.

Field interlacing is used and six fields are required to produce a complete color picture.

COLOR FLICKER

At the standard black-and-white field frequency of 60 per second, a six field picture would be produced only each 1/10th second—not fast enough to avoid "flicker" on scenes which are predominantly of one color. Therefore, field sequential transmission of color required 144 fields per second. This gives 24 complete pictures per second, which is safely above the "flicker" rate.

At the receiving end, the field sequential system employs a process which is the reverse of that used for transmission. The picture tube is viewed through a rotating color wheel which is synchronised with the one at the transmitter in both speed (1440 rpm) and phase.

A filter of the same color is thus before both the camera pick-up tube and the receiver cathode ray tube at any given time.

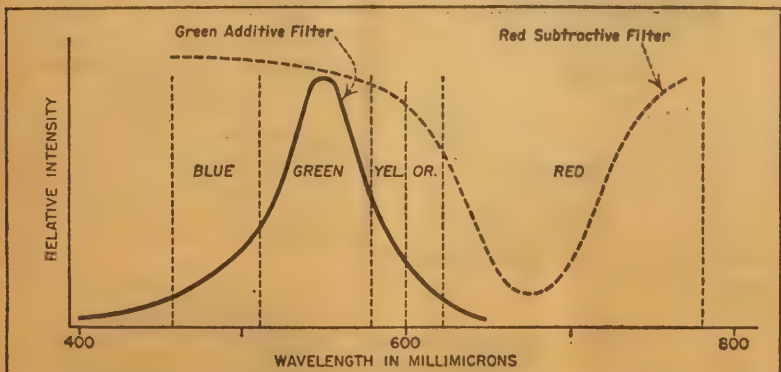


FIG. 1

light passing through it, leaving a complex hue made up of all other colors, while an additive filter absorbs all colors in the spectrum but one.

In this respect the subtractive color filter is analogous to an electrical band-rejection filter, while an additive color filter is like an electrical band-pass filter.

This concept is illustrated in Fig. 1, which shows the response of an additive color filter as a solid line and that of a subtractive filter as a dotted line.

It is important to realise that both filters in Fig. 1 would appear green to the eye. However, whereas the green additive filter has a sharp pass-band in the green region, the subtractive filter's main characteristic is a sharp rejection curve in the red region. It therefore passes green along with yellow, blue violet and extreme red.

In all practical systems of color television, the additive primary colors are transmitted one at a time. However, if two or three of the primary colors are transmitted in a time in-

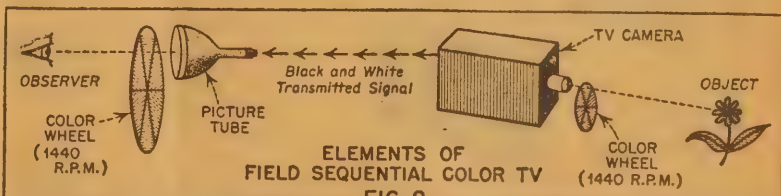


FIG. 2

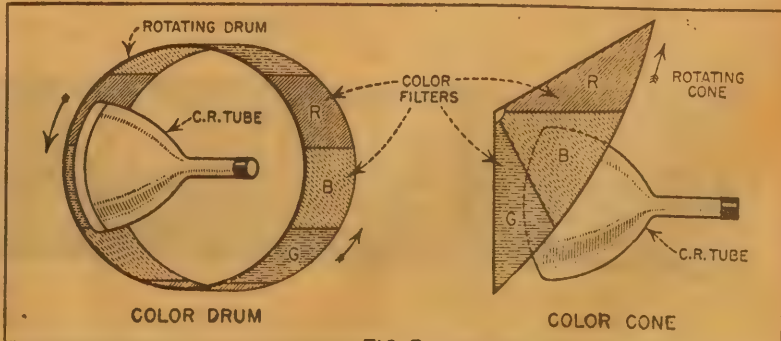
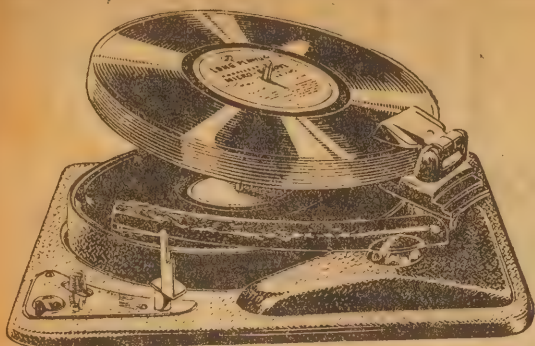


FIG. 3



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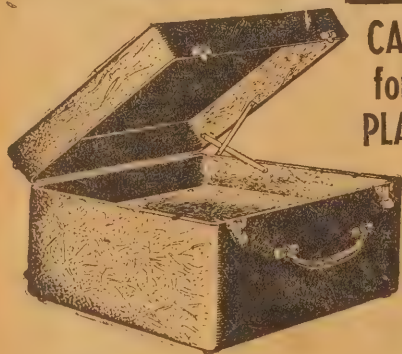
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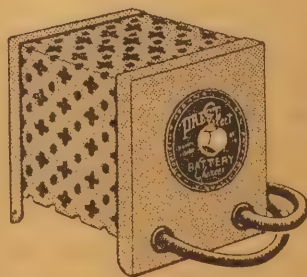
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Suppose the color is green. The camera tube then "sees" only the green elements of the picture and these are transmitted in the usual manner to the receiver which produces them as white light. The additive filter between the viewer and the picture tube passes only the green light, however, so that the green highlights of the picture are faithfully reproduced.

The green field is rapidly followed by one in red, one in blue, etc. The intermediate colors in the picture are then formed by the superposition of the primary fields on the retina of the eye.

The advantage of the field sequential system of color TV are mainly the economy and simplicity of the equipment required. For the expenditure of only a few dollars, many experimenters have converted standard receivers to satisfactorily receive test transmissions in color using this system. Other advantages include excellent color fidelity.

NOT COMPATIBLE

The major disadvantage of the system is that it is not "compatible." This means that a program transmitted in color by the field sequential method cannot be received in black-and-white on standard receivers without modification.

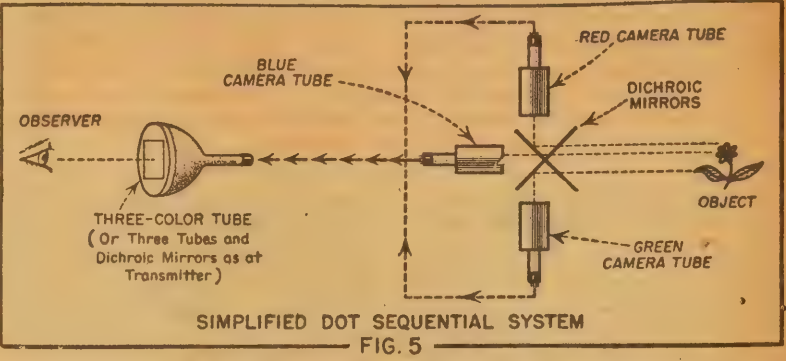
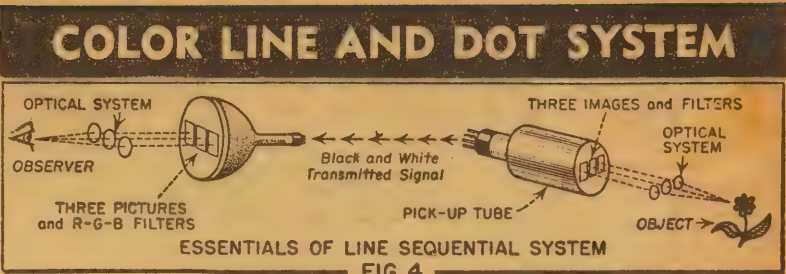
Since the color transmissions use a horizontal line frequency of 29,160 instead of the standard 15,750 lines per second, and a vertical sweep frequency of 144 per second rather than the present 60 per second, sweep circuit changes must be made in the existing sets to permit reception in either black-and-white or color.

This is termed "conversion" and ranges in complexity from very minor changes in some sets to major redesigns in others. The task of performing such conversions would probably fall to the TV service technician who is qualified for such work.

Another disadvantage of the field sequential system, as it is presently being demonstrated, is the bulkiness of the mechanical color disc.

Since each of the six color filter segments arranged on this wheel must be large enough to cover most of the picture tube face, the wheel must be at least twice the diameter of the tube. This sets a practical limit on the size of the picture tube which can be used—tubes larger than about 12½ inches requiring discs of ungainly proportions.

However, magnification can easily be employed to provide larger pictures from small tubes. Other forms of the color wheel, such as the color cone or color drum shown in Fig. 2, have form factors more adaptable to



TV cabinets. No problem exists at the transmitter, since the filters used need only be large enough to cover the camera lens.

The field sequential system is not essentially "mechanical." The color wheel could readily be replaced with an all electronic, three-color picture if a practical one were commercially available.

SEQUENTIAL LINES

Another method of color transmission which has been demonstrated is called line sequential. As the name implies, colors are switched sequentially after each line rather than after each field. Therefore, color switching occurs 15,750 times per second instead of 144 times as in the field sequential system.

Each of the standard 60 fields per second is made up of alternately red, green and blue lines. Line interlace is used and six fields must be sent before each of the 525 lines is scanned in each color. This results in only 10 complete "frames," or pictures, per second. However, flicker is minimised to a large extent by the line interlacing.

Fig. 4 shows the elements of the line sequential system. At the pick-up end, an optical mixing arrangement consisting of three lenses and three color filters focuses the scene being televised on the camera tube mosaic so that the three color images

appear side by side. The electron beam sweeps across all of the pictures in succession to generate sequentially colored lines.

Here again the transmission process is reversed in receiving colored pictures by the line sequential system. Three images containing the separate color information are reproduced side-by-side on the picture tube face. These images are viewed through separately colored filters and an optical system which superimposes them so that they appear to the observer as one colored image.

Since the line sequential system conforms to present TV standards it is compatible and could be received equally well on either black-and-white or color receivers. Its major disadvantage is an effect called "line creep" or "line crawl" which is particularly distracting to the eye since prominent color lines seem to be moving up or down through the picture.

SEQUENTIAL DOTS

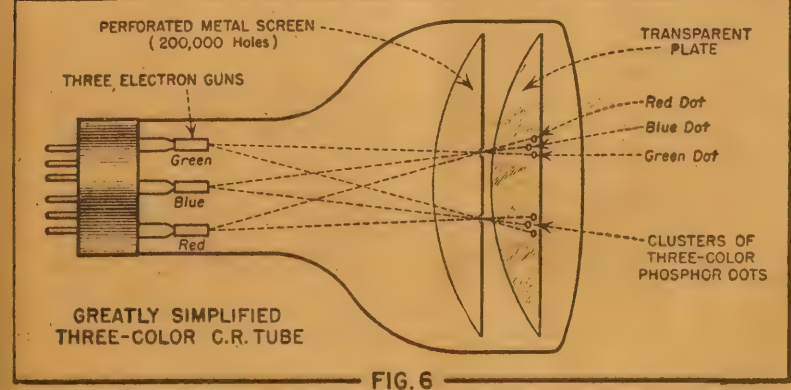
The dot sequential method of color transmission goes one step farther than the line sequential approach and breaks each line up into many picture elements or "dots" which are transmitted sequentially in the three primary colors.

To do this, color switching must be accomplished almost 11 million times per second. This high sampling rate is responsible for both the good features and some of the bad features of this method, as will be mentioned later.

To transmit dot sequential television, three separate pick-up tubes are used. The televised scene falls on the three mosaics through a system of dichroic mirrors, as in Fig. 5. Each mirror is transparent to two primary colors but reflects the third. Thus each tube receives picture information in one color only.

An electronic sampling system connects the transmitter sequentially to the output of the three camera tubes at the rate of 3.6 million cycles per second. Each line consists of about 420 dots in alternate colors. Four fields are used per frame — two

(Continued on Page 59)





Here's your answer, Tom!

Two of Tom's queries this month are about matters which often come up in the query service so we have taken the opportunity of publishing fairly full answers here. In order to discuss the first one it is necessary in passing to mention logarithms but, even if Tom doesn't know much about mathematics, he shouldn't have any difficulty in understanding the trend of the discussion.

WHAT is a decibel? How does it compare with volts and amps?

First of all, Tom, our thanks for bringing up the query. It is one that has bothered beginners of all times. Several hundred years ago Hamlet asked "db or not db?" Possibly he was having a little bother with feedback in the Royal Danish Amplifier System.

The decibel is a unit which has been introduced to reconcile the hard facts of mathematics with the peculiarities of the human ear.

If for the purposes of experiment you take some unsuspecting victim and sit him up in front of a loud-speaker which is radiating audio frequency power, the quantity of which you are able to measure, he will be able to make a mental note of how loud the sound seems to him. If, then, you increase the power until it sounds twice as loud to our victim and measure the new power on your instruments you will illustrate a very interesting fact.

The sound that appears to have double the intensity to the ear has much more than twice the power of the original sound.



The ear has a sort of automatic volume control system so that it is very sensitive when it is called upon to hear weak sounds but becomes increasingly less sensitive as the strength of the sound increases.

In a quiet room we are able to detect the slightest noise, yet the volume of sound in the vicinity of an aeroplane engine is still bearable, though it may have an intensity many millions of times as great as the first sound.

The sense of sight is also able to

protect itself against overload. Look closely at someone's eyes when they are exposed to bright sunlight. The diaphragm closes up to almost a pin-point, allowing only a small part of the light to reach the sensitive part of the eye. In weak light the diaphragm opens to make best use of the available light.

Experiment has shown that the ear's response to sound is approximately proportional to the logarithm of the magnitude of the sound, so that it is convenient to use a system based on logarithms to compare the sound magnitude.

This is where the decibel comes in, Tom. The decibel is a unit which allows us to compare two power levels. Actually, the basic unit is the bel, but as this is too large for most applications the decibel, or 1-10th bel, is the unit most used.

The system is based on logarithms to the base 10. A change in power level in bels can be calculated by dividing the greater power by the lesser and taking the logarithm of the result to the base 10. To convert the figure to decibels simply multiply by 10.

An example will make the argument clearer. We will take the case of a power level of six watts, which is then decreased to three watts. The problem is to calculate the decrease in power in db. The answer is:

$$10 \log_{10} \frac{6}{3} = 3.01 \text{ db.}$$

• 3 db approx.

Note that you would still have a change of 3 db if you changed the power from 12 watts to six watts. Further, even the units are not important. The only factor which need be considered is the ratio of the two powers.

Strictly, therefore, you cannot say that an amplifier has an output of so many db. However, the decibel system can be extended by establishing a reference level. Power levels either higher or lower than the reference level can then be compared with it in terms of db. A plus or minus sign indicates whether the power level being considered is higher or lower than the reference level.

Unfortunately, a number of different reference levels have been used in the past and there is a certain amount of confusion. A power of six milliwatts is frequently used, being a convenient value for the 500 ohm interconnecting circuits frequently used in audio work. The same power

level is often applied to 600 ohm line circuits which are standard for some applications. Again, reference levels of one, 10 and 12.5 milliwatts are sometimes used.

Because of the usefulness of a decibel system, but at the same time the confusion caused by the lack of a universal standard reference level, the volume unit, or vu, has been introduced. In this case the reference level is equal to 1 milliwatt in a load of 600 ohms.

Using the vu, it is possible to describe the output of an amplifier without further qualification. If, for example, you state that an amplifier is delivering an output of 50 vu, you mean that the output is 50 db above a reference level of 1 milliwatt.



While it is strictly correct to speak about the output of an amplifier or microphone as so many vu, the gain of an amplifier or the loss in an attenuator should be given as so many db. Then, if you have, say, a pickup delivering a 2 vu feeding into an attenuator with a loss of 6 db which in turn feeds into an amplifier with a gain of 35 db, the output of the amplifier will be 31 vu. As you see, with the decibel system gain and level calculations resolve themselves into a simple matter of addition and subtraction.

While it is not strictly correct, some manufacturers do speak about the outputs of microphones, &c, as so many db. Usually the user of the equipment is aware of the reference level, but if this is not the case the specifications really do not mean very much.

The use of the decibel idea is frequently extended to voltage amplifiers (ie, amplifiers where the power involved is not so important as the voltage developed). In order to be strictly correct, the load across which the voltage is developed should be stated so that the power can be calculated but, when the voltage is the most important consideration,

it is often convenient to ignore the difference in the value of the load. The formula then becomes:

$$20 \log \frac{V_1}{10 V_2}$$

Note that a 2/1 change in voltage corresponds to a change of 6 db. Where this convenience is adopted it is desirable to speak about decibels of voltage, or dbv.

That should satisfy your curiosity, Tom, but just to give a complete answer to the last part of your question, power is equal to the product of current and voltage in the circuit being considered. Impedance is equal to the ratio of voltage and current.

I have noticed in valve data books that rectifiers can have capacitive input filters, inductive input filters or choke input filters. Could you explain the difference between these and the advantages of each one?

First of all, Tom, inductive input filters and choke input filters are one and the same thing. The difference between these and capacitive input filters is often a matter of regulation.

In case you haven't come up against it, Tom, they use the word "regulation" in radio as well as in governments. The government variety has never ceased to gain in complexity and uselessness since William the Conqueror landed on British soil but, fortunately, the radio variety does serve some useful purpose.

In connection with power supplies, the word "regulation" describes the relationship between the output voltage and the varying amounts of current which may be drawn from the supply.

But let's get back to inductance (or choke) input filters. You probably know that one of the properties of an inductance is to resist any change in the flow of an electric current through it.

CURRENT LAG

For example, if you connect a battery across an inductance, the current will not reach the full value determined by the DC resistance of the wire for some definite amount of time. The time depends on the value of the inductance. Conversely, when the circuit is opened the current will try to keep flowing for a further definite period.

Well then, when a choke is placed in a power supply, which is delivering an uneven output, it will tend to make the output current smoother.

It will prevent the current rising steeply on peaks, but it will also try to keep it flowing during troughs.

By way of contrast, when a condenser is connected across such a supply, it will charge up to the peak voltage but, when the supply voltage falls some of the energy stored in the condenser will be re-delivered to the circuit.

So it is that, if a condenser is connected across an irregular supply, it will try to keep the voltage at an average level by absorbing energy on the peaks and re-delivering it on the troughs.

Consider now what happens when a condenser is connected across the output circuit of a rectifier valve. If

there is no load on the circuit the condenser charges up to the peak value of the voltage on the first half of the cycle and remains at that value. If there is a load on the circuit the condenser will discharge as the voltage delivered by the rectifier drops, in an attempt to keep current flowing in the load.

In a practical choke input filter circuit there is a series choke and then a parallel condenser. The main characteristics of the supply are determined by the choke, the condenser being present to provide extra filtering. The characteristics of such a supply are that it tends to deliver a fairly constant voltage with varying load.

In other words, the regulation is good.

With a given transformer and rectifier valve, a condenser input filter will deliver a higher voltage than a choke input filter, because the condenser charges up to the peak value of the output of the rectifier. However, as the load is increased the condenser is discharged to a lower value between each half cycle and the output voltage decreases by a corresponding amount.

Condenser input filters are charac

terised by high output voltage for a given transformer voltage, but poorer regulation than the choke input filter circuits. They are frequently used in receiver circuits where the output valve is operated in class A and the regulation is not so important. Further, a sufficient amount of filtering can often be obtained with one choke and two condensers, while a choke input filter would necessitate two chokes and two condensers to keep the hum down to an acceptable level.

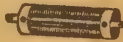
SPECIAL CASE

A rather interesting arrangement is sometimes used in the case of power supplies for class "B" modulators in transmitters. A characteristic of class "B" modulators is that they draw small values of high tension current with no signal applied, but large currents when a large signal is applied. For optimum operation the power supply for a class "B" stage should be well regulated.

The filter choke is designed so that it has a high value of inductance when the current passing through it is small. However, the core is so arranged that, when a high current is passed through the choke, it be-

(Continued on Page 59)

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The space occupied by the tuning chart in the previous unit is now taken by the knob for the compensating condenser. Even with the additional data, there is room for a new tuning chart between the two knobs.

to compensate for the incorrect line length before connecting it to the aerial feed circuit.

Without discussing the theory of the subject too deeply, it can be observed that a transmission line which is electrically resonant looks like a resistor as far as the transmitter is concerned while a line which is too short or too long looks like either an inductor or a capacitor.

Thus if you connect a line having capacitive reactance across the aerial tuned circuit it has the same effect as connecting a capacitor of the same value across the circuit: the variable condenser has to be set at a lower value of capacity to reach resonance. The reverse is true in the case of a line with inductive reactance.

However, if a line has capacitive reactance, it is possible to make it look like a resistance by connecting an equivalent amount of inductive

MORE ABOUT AERIAL TUNERS

Details of additions to the aerial tuning unit for the 5-band transmitter, which allow it to be used with feeder lines of non-standard length, are given in this article together with constructional details of an excellent wooden rack for mounting the equipment. The rack can be made at home and makes the complete station easy to adjust and operate.

WHILE the aerial tuning unit described last month does provide an excellent means of coupling the transmitter to a multiband aerial system it has the disadvantage that, for efficient operation, it is necessary for the feeders to be cut to multiples of a quarter wavelength.

At the same time, many amateurs find that it is convenient to string an aerial between, say, a mast and a chimney and the convenient length of the feeders is more or less fixed.

To shorten the feeders may mean a sacrifice of height and hence radiating efficiency, while to lengthen the feeders to the next exact multiple of a quarter wavelength may mean a sloppy feed line free to blow against trees, guttering, &c., or at best, many more feet of wire suspended in the air than is strictly necessary.

NEED FOR COMPENSATION

If the discrepancy between the optimum length and the most convenient length is only a few pc. in terms of wavelength, compensation can be made by adjusting the normal aerial tuning condenser. Should the line be too short in a particular case it will be found that resonance is reached with greater capacitance with the aerial connected than in the unloaded condition. On the other hand, if the feed line is a little too long, less capacitance will be required.

In following the normal tuning procedure, therefore, we automatically compensate for the inevitable small discrepancies in the line length.

However, a point is eventually reached where, to compensate by adjusting the tuning condenser results

by Maurice
Findlay

in poor efficiency of the aerial tuning circuit.

Furthermore, there will be cases where the range of the tuning condenser is not sufficient to allow the system to be brought to resonance.

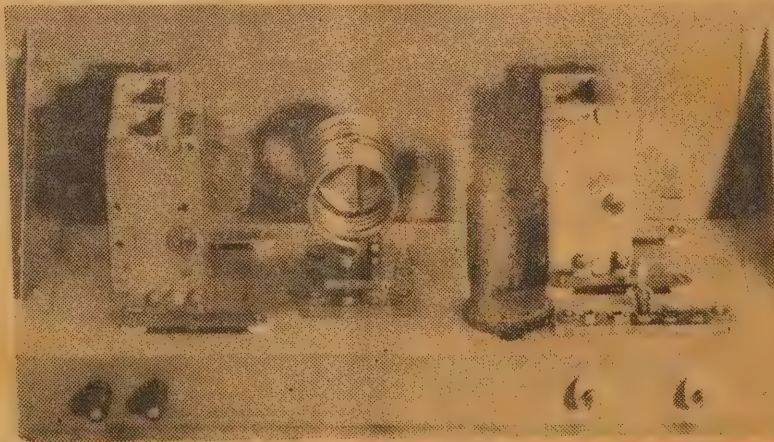
The remedy of these difficulties is

reactance across it. If it has inductive reactance, a compensating condenser is required.

Therefore, by providing the aerial tuning unit with a suitable variable capacitor and a variable inductor, it is possible to make almost any length of feeder look like resistance. Thus the feeder can be connected to the aerial tuned circuit without upsetting its desirable characteristics.

The requirements for the auxiliary condenser and inductor are not difficult to meet.

For transmitters of reasonably modest power, an ordinary single section 400 pf variable condenser is suitable, while a coil having the desired characteristics can be wound with ordinary enamelled wire on a



The additional components are mounted on the right hand side of the chassis looking from the rear. The variable plug and set of sockets can be seen just above the output terminals.

former of a type which is readily available. Taps are required so that inductance can be adjusted to a suitable value but this does not introduce any special difficulties.

The tuning procedure with the compensating reactances in circuit is generally similar to that described last month except that the aerial reactance is cancelled before an attempt is made to adjust the loading to the desired value.

Start with a very loose value of coupling between the transmitter and the aerial tuning unit. (Use a temporary link at the transmitter end if necessary.) With the transmission line disconnected, tune the aerial circuit to resonance and note the setting of the condenser. Connect the feeders to the pair of taps closest to centre tap and check the resonance point again. (It may be necessary to increase the coupling to obtain a definite indication.)

If the setting of the condenser has changed very little, neither of the compensating reactances will be required, and the wander plug should be placed in the blank socket. However, if more capacity is required, connect the compensating condenser into circuit by means of the wander plug and adjust it until resonance can be reached with the main tuning condenser at its original setting with the circuit fully loaded.

SELECTING TAPS

Conversely, if less capacity is required to reach resonance with the feeders connected than originally, it will be necessary to select the tap on the compensating coil which allows resonance to be reached with the main tuning condenser closest to its original setting.

Note that the coil and the condenser are never required at one and the same time.

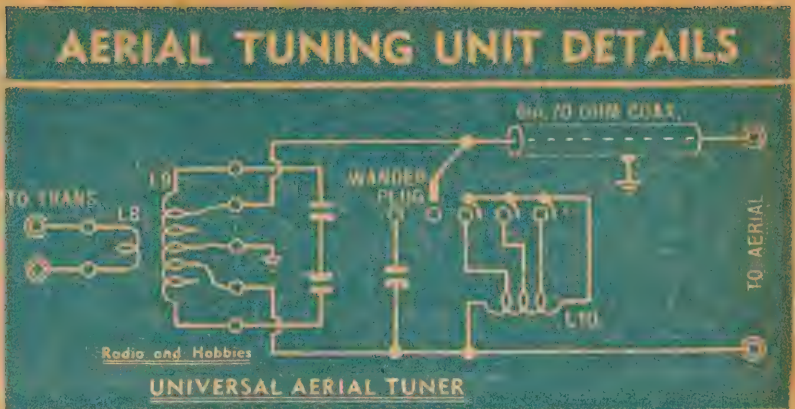
If only a small portion of the inductance is required it is undesirable to have the remaining portion floating unattached. Provision is, therefore, made to short the unused turns. In our case, the desired result is achieved by shorting strips manufactured from thin sheet brass, and arranged so that the unused section of the coil is shorted out when the wander plug is placed in the appropriate socket. An alternative would be to use a second wander plug and set of sockets.

Most of the information required to duplicate our aerial tuning unit may be gained from the photographs, circuits and coil table. The single section condenser is mounted on ceramic stand-off insulators and an insulated coupling is used between the shaft and the control knob.

MECHANICAL DETAILS

The sockets which, together with the wander plug, allow the appropriate compensating reactance to be selected are mounted on a strip of polystyrene, 3½ in x 1 in x 3-16 in. It is most unlikely that more than three of the taps on the coil will be required with any particular aerial system so that we have provided for only three sockets.

The leads to the taps which you find you do not require can be cut short to avoid the possibility of their touching the chassis, &c. Extra leads can always be soldered on if a change in the aerial system



COIL WINDING DATA

3.5 Mc. L9 34T 20 B & S closewound on 1½ in former. Tapped at 4, 8, 12, 16, 18, 20, 22, 26 and 30 turns. L8 from 1 to 4 turns as required.

7.0 Mc. L9 24T 14 B & S spaced 2 in on 1½ in former. Tapped at 2, 4, 6, 8, 10, 12, 13, 14, 16, 18, 20 and 22 turns. L8 from 1 to 4 turns, as required.

14.0 Mc. L9 15T 14 B & S spaced 1½ in on 1½ in diam. former. Tapped at 2, 4, 6, 7,

8, 10 and 12 turns. L8 1 to 3 turns as required.

21.0 Mc. L9 11T 9 B & S spaced 2 in on 1½ in former. Tapped at 1, 2, 3, 4, 5, 6, 7, 8, 9 and 10 turns. L8 1 to 2 turns, as required.

28.0 Mc. L9 9T 9 B & S 1½ in diam spaced 1½ in self supporting. Tapped at 1, 2, 3, 4, 4½, 5, 6, 7 and 8 turns. L8 1 to 2 turns, as required.

L10 26T 14 or 16 B & S (preferably 14) closewound on 1½ in diam. former. Tapped at 3, 6, 10, 14 and 18 turns.

makes it necessary to use different taps.

As the compensating reactances are permanently connected to one side of the transmission line there is a greater capacity between that line and earth than the other. The circuit is to some extent self-balancing, but, in our case, the lead between the remaining feeder line and earth was run in 75 ohm co-axial cable, the outer braid of the cable being earthed.

The losses in the short length of cable are so small as to be neglected, but the capacity between the inner conductor and the outer braid helps to balance the capacity between the respective feeders and earth.

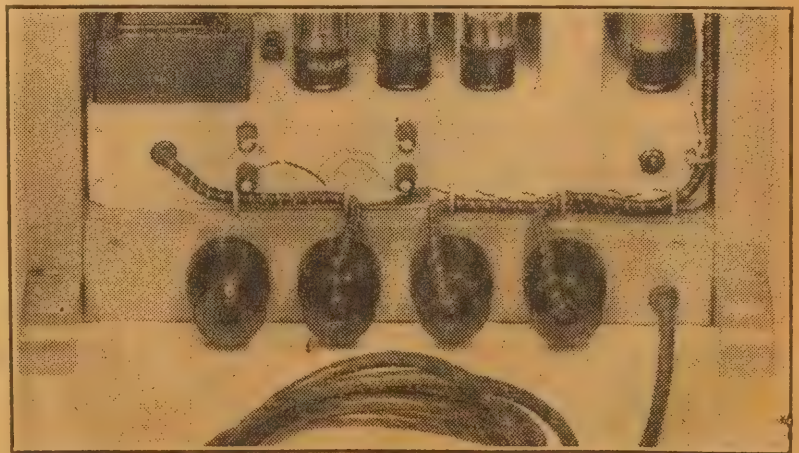
So much for the details of the aerial tuning unit. Now for a few general remarks.

Any amateur who builds a transmitter complete with modulator and aerial tuning unit is likely to be

interested in a method of mounting the equipment in such a way that it can be operated and serviced easily and at the same time have a neat and businesslike appearance.

Some amateurs will have a set of shelves in the shack and the various units can be arranged neatly side by side or one above the other, with appropriate interconnecting wires. Care should be taken to provide good earth connections between the chassis to obviate the possibility of RF feedback when the transmitter is used on phone.

There is an excellent argument, however, for mounting the units in a cabinet or frame so that they fit together neatly and can be removed easily when necessary. In the case of commercial installations, transmitter cabinets are frequently constructed from angle iron and sheet metal, but, unfortunately, few ama-



A set of three pin sockets for power distribution is mounted at the rear of the rack. The standard power plugs allow the various units to be plugged into the power mains separately if required for testing purposes.

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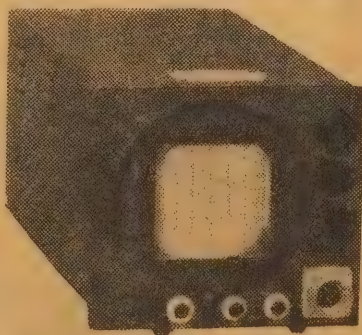


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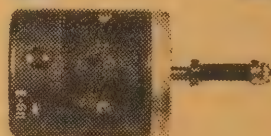
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teurs have access to suitable metal working facilities.

However, provided due care is taken, an excellent rack for housing the transmitter can be made from wood. Our effort at making a wooden rack is shown in the photograph.

Our rack was made from 1½in x 1½in stock, but anything between 1in x 1in and 1½in x 1½in should be satisfactory. If you can buy dressed timber, about the only tools you will need are a saw and a small chisel. A small tenon or dovetail saw would be ideal, but you could do an excellent job with an ordinary hack saw. The chisel should have a blade 3-8in or so wide, depending on the size of the timber and the type of joint you find most convenient. While there is no need for elaborate joints at any of the corners, it is as well to make some provision in this regard rather than rely on butt joints.

There are several ways of making corner joints as you will note if you study common articles of furniture. An excellent method is to cut a tenon on the ends of the cross pieces and a corresponding socket in the upright. In this case, a suitable size for the tenon would be 3-8in wide and ½in deep.

CORNER JOINTS

An alternative which some may find easier is to use dowelled joints. In this case dowel about 3-8in diameter would be suitable leaving room for two dowels at each joint. It is necessary to glue all joints of this nature, of course, and ordinary hide glue may be used if available.

Some may find one of the powdered casien glues more convenient since it is not necessary to have any heating facilities. The powder is simply mixed with water, according to the directions, and allowed to stand for about 15 minutes.

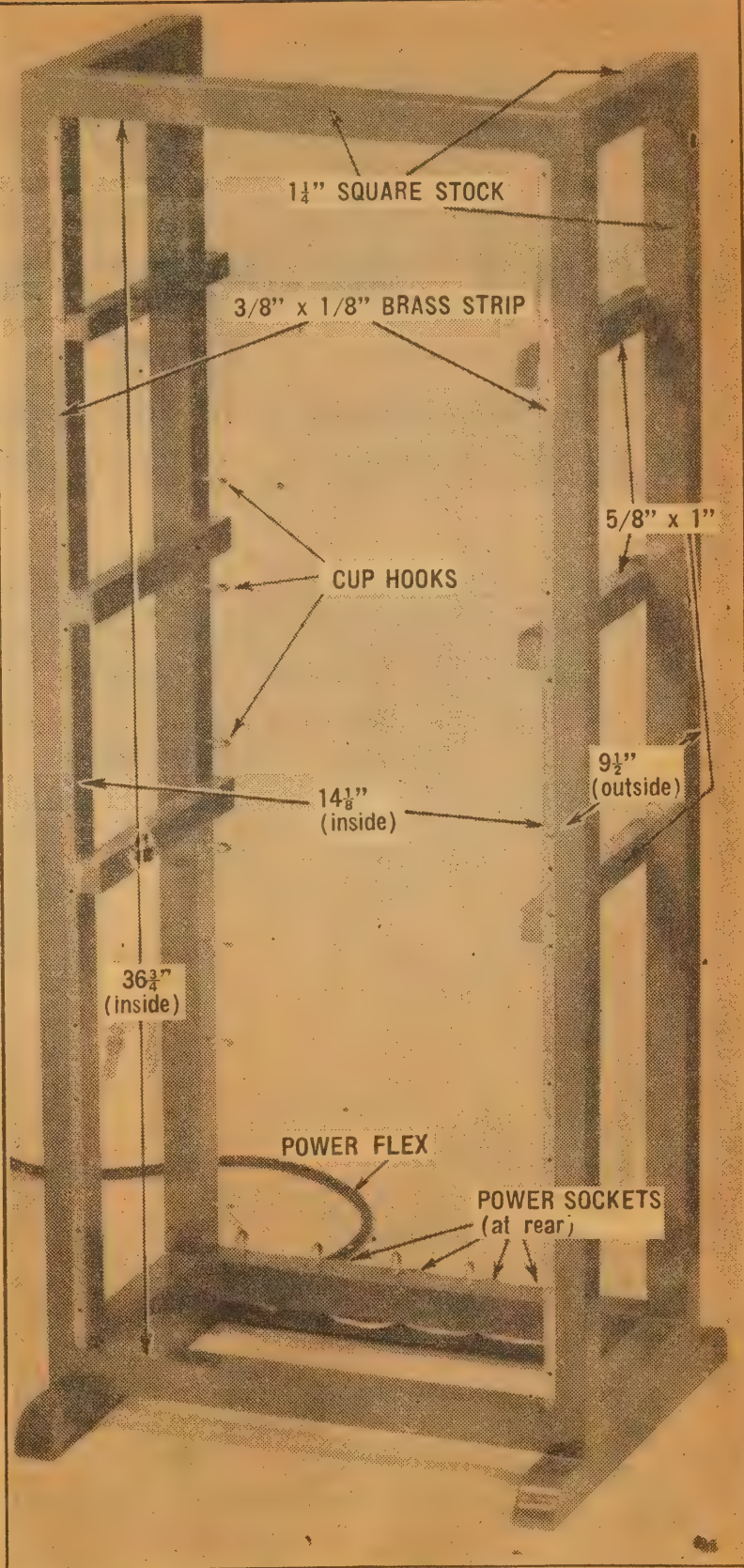
When first mixed, the glue gives the impression that insufficient water has been added, but after it has been allowed to stand for the prescribed period it will assume the usual consistency of glue. When properly dry casien glue is waterproof.

The feet are added to the rack with the object of improving its appearance and at the same time making it less likely to tip over. They may be held in place by means of the glue only or, if you are fussy, leave tenons on the bottom ends of the uprights and cut corresponding mortices in the feet. Extra trouble in fitting the feet can add to the strength of the rack.

The units may be held by means of wood screws passing through holes in the front panels into the front uprights. In the interests of appearance, it is worth while to try for nickel-plated screws and you may be able to obtain a type with matching nickel-plated washers.

The original equipment is destined for service at the writer's amateur station, where it is likely to be the victim of extensive experimental work and the chassis are likely to be taken in and out of the rack a good many times.

Although, if carefully fitted, the wood screws would stand up to a good deal of service, we thought it worth while to arrange something more elaborate.



Our rack was constructed from 1½in x 1½in pine. Cyprus, oregon, colonial pine or pacific maple are among the timbers that would be suitable. The finished job was given a coat of dark battleship grey paint to contrast with the horizon grey used for the panels.



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- Signal/noise ratio*: 60 db (unweighted) below peak recording level (2% total harmonic distortion) measured over a band width of 50-15,000 c.p.s.

HIGH COERCIVITY EMITAPE TECHNICAL DATA

Thickness	
Backing	.0016"
Coating	.0005"
Total	.0021"
Tape Width	.25" + 0 -.004"
Tensile Strength	4½lb per ¼" width.
Elastic Elongation at 1lb	Less than .5%.
Recommended Operation Tension	3oz.
Yield Point	4lb.
Longitudinal Humidity Coefficient	8 x 10 ⁻³ % per % R.H. (40—95% R.H. at 77°F.)
Longitudinal Thermal Coefficient	5 x 10 ⁻³ % per °F. (30—130°F.)
Coercivity	270 oer.
Remanence	.50 flux lines per ¼".
Print Level at 15"/sec.	—60 db. for 5 minute contact and instantaneous playback at 65°F.
Instantaneous variation in Sensitivity along tape length-maximum	Plus and minus 1½ db.
* Measured on an EMI Tape Recorder.	

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Western Australia: Wyper Howard Ltd., 671-3 Hay St., Perth.
Queensland: A. E. Harrold, 123-125 Charlotte St., Brisbane.

Brass strips were inserted in an appropriate rabbet cut into the inside edges of each of the front uprights. The brass is screwed to the wood at frequent intervals and the chasses are then screwed to the brass strips by means of 3-16in metal screws. You will need a tap corresponding with the metal screws.

If one is not available and cannot be borrowed it will cost only two or three shillings to buy. A taper tap will be satisfactory, since it does not matter if the pilot hole has to be driven some distance into the wood.

Brass is difficult to obtain at the moment, so that you may have to make do with something other than the ideal. Copper may be used if you can get it, but it is slightly more difficult to tap. As a last resort, you could use mild steel, in which case it would be necessary to give it a coat of paint to prevent rusting.

The metal strip also has the important advantage that it provides a low resistance connection between chasses, but you can achieve a similar result by tacking brass shim, narrow enough to be covered by the panels when the units are in place, down the front of the rack. Masking-tape or ordinary plastic tape can be used to avoid getting paint on the conducting strip.

OUR DIMENSIONS

In our case, the brass strip is 3-8in wide by 1-8in thick, but it could be made up to 1in wide without the danger of being visible with the units assembled.

The exact height of the rack depends on how you intend to use the equipment. Some may wish to construct a small rack to contain the transmitter and modulator only, while others will wish to include the aerial tuning unit.

In our case, it was desired to include a receiver in the same rack and space has also been left for a blank panel which may later be used for certain accessory equipment. Even so, the overall dimensions are still small enough to allow the assembled rack to be carried on the back seat of all but the smallest of cars, making it an excellent proposition for field days.

The receiver shown in the photographs is the "Short-Wave Seven," which was described in the March, 1949, issue of Radio and Hobbies. The panel is 9in high. An additional 6in has been allowed for the plank panel.

For those who are interested, copies of the schematic circuit and also a blueprint of the receiver chassis are available through the query service. Some may wish to build a more elaborate receiver employing bandswitching and miniature valves. While we can make no definite promises at this stage, we may be able to present such a receiver at a later date.

There are one or two kinks which we found invaluable in fitting the chassis into the rack. Rather than attempt to work with the rack upright we laid it horizontally on two boxes to make a convenient working height. The units could then all be placed in the rack at the same time without the need for the screws, making it easy to find the optimum position for each panel. Small errors in the panels can be corrected before any screw-holes are made.

After making any necessary corrections mark the positions of the holes and in each case drill a pilot hole,

(Continued on Page 90)

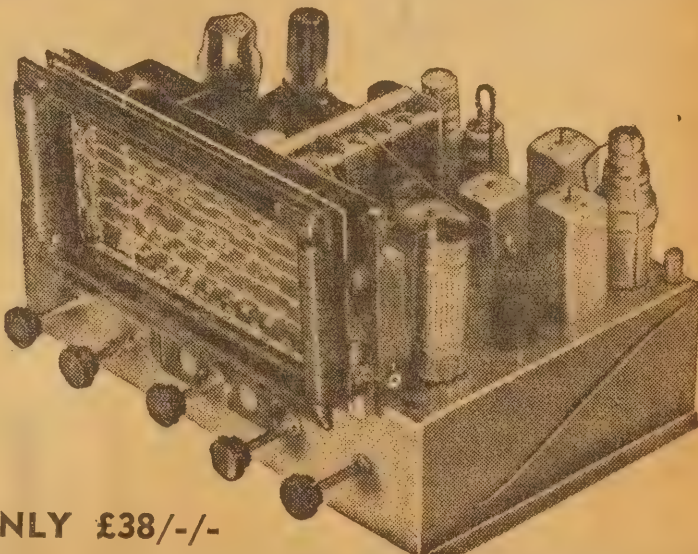


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8 watt output).

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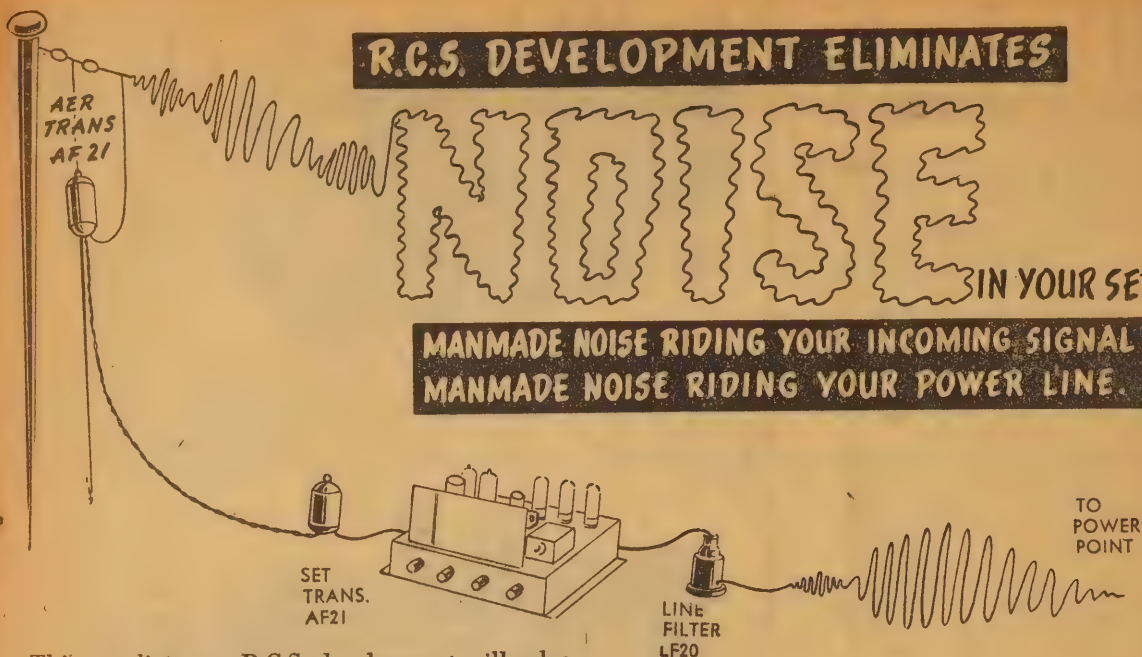
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With this new amazing R.C.S. development you can now eliminate outside man made interference and hear, for the first time, the true reproduction qualities of your receiver. Both the aerial and the line filters, for the few shillings they cost, will add pounds to your enjoyment in improved reception.

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AERIAL FILTERS

AF21



LINE FILTER

LF20

The aerial filter consists of two transformers—one is situated close to the aerial, the other close to the aerial and earth terminal. Your set requires no alteration whatever and any amateur can fit the R.C.S. aerial filter in half an hour.

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AMPLIFIERS FOR TAPE RECORDING

While the mechanical requirements of a tape recorder are obvious enough, little data has been published in popular journals covering the design of the amplifiers and bias oscillator. The preliminary article outlines the problems involved and leads up to a further article, next month, which will contain actual circuit details.

By P. D. THOMAS

ONE of the attractive characteristics of magnetic tape recording is the fact that the circuit requirements are not critical, and quite good results can often be achieved with any amplifier which happens to be handy, combined with some sort of bias oscillator thrown together with parts from the bottom of the junk box; and possibly, for erasing, the magnet which is kept in the workshop for retrieving dropped nuts and bolts.

Yet for the best results of which tape is capable, there are certain special requirements of the recording amplifier and associated circuits which are lacking in such makeshift equipment; and in the following pages these special requirements are considered in detail.

SEPARATE CIRCUITS

Although in practical recorders part of the circuit is often used for both recording and playback, for the sake of economy, by means of appropriate switching, the record and playback circuits will first be isolated for the purposes of discussion and treated as separate units.

Any audible frequency, within the limits set by the design of the equipment, and any sound vibrations within those limits, which can be converted into an electrical waveform, may be recorded on tape and reproduced as often as they are wanted.

Typical sources of recorded material are: radio programs, disc recordings, reproduced by a pickup; electronic musical instruments; CW (code) signals, either "home-made" or picked up on a radio receiver; telephone conversations (check regulations on this point); and any kind of speech, music, or just noise which can be picked up by a microphone.

In practice, a radio receiver is the handiest source of AF, while the microphone is the most versatile; so these two are likely to be used most.

It happens that they represent the

extremes of input level—the output of the average receiver is much higher than is needed for recording, while that of a good-quality mic is lower than any other signal likely to be used—so if the recorder can handle either with equanimity, it is prepared for anything else it will be called upon to accept.

In general there are two types of input to the record amplifier: low-level, as from a ribbon of moving coil mic; and high-level, as from a radio tuner, pickup, preamplifier or mixer unit, or landline.

The output level required for recording varies slightly with different tapes, head designs, and bias circuits; however, it is normally less than one watt, and a medium-mu triode, such as a 6C5 or 6J5, is suitable to feed the head for ordinary work. In a high-fidelity recorder larger tubes, and perhaps a push-pull circuit, might be used to minimise distortion.

VOLTAGE AMPLIFIERS

The output or driver stage would be preceded by at least one voltage amplifier for a high level input, with an additional preamplifier if a low level input is used.

Fig 1 is a block diagram showing such an arrangement. Either triodes or pentodes may be used in voltage amplifier stages; pentodes are preferable in low-level, high-gain stages, while triodes handle a large grid swing with less distortion in stages operating at higher levels. Resistance-capacitance coupling between stages is accepted practice.

The control shown in Fig. 1 is a master gain control, but there is no reason why any number of inputs should not have individual faders; this would be determined by application requirements.

Due to the inherent characteristics of tape recording the response rises with frequency until a point is reached which is roughly half the cut-off frequency; thereafter the response

falls until the cut-off frequency is reached, where it is zero.

In Fig. 2, curve A illustrates this. To make the overall response linear over the usable frequency range it is necessary to boost both the upper and lower ends of the range. This can conveniently be done before recording by tailoring the response curve of the amplifier so that it will correspond approximately to B in Fig. 2.

In some cases the correction is done partly in the record and partly in the playback amplifiers; there is as yet no accepted standard recording characteristic such as is used in disc recording.

The amount of correction required depends upon the design of the head to a large extent, and also upon the tape speed. In general, less correction is needed as the tape speed is increased or the gap length is decreased, other factors being equal.

A typical top boost circuit is shown in Fig. 3.

If the head inductance is reasonably high the response at lower frequencies may be sufficient for some purposes, but to obtain an adequate bass response a certain amount of bass boost is desirable. A typical circuit to achieve this is shown in Fig. 4.

CIRCUIT VALUES

The values given in these circuits are examples only; the exact value of C, which determines the frequency at which the boost becomes effective in both circuits, may be calculated or found experimentally to give the frequency range needed.

The associated resistor R, which determines the degree of boosting, may be made variable or semi-variable to simplify adjustment of the frequency response in the experimental stages.

Not only does the amount of boost required depend upon the design of the head and the tape speed; the range of frequencies over which the correction must be effective also depends upon these factors.

Doubling the speed, for instance,

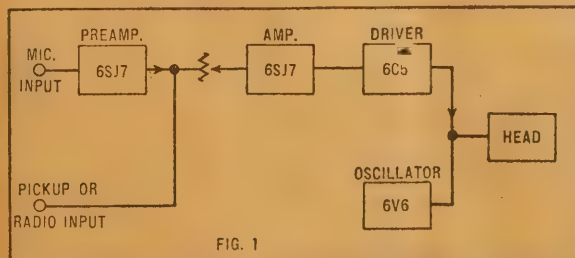


FIG. 1

Block diagram of a tape recording amplifier, showing the essential stages for a simple recorder.

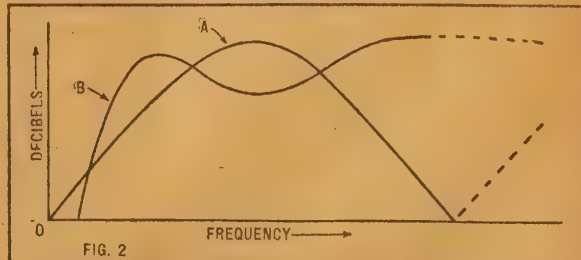


FIG. 2

Illustrating (A) the natural recorder response and (B) the type of compensation required.

STANDARD



RANGE

For Output Transformers see other ad in this issue

RECEIVER POWER TRANSFORMERS

CODE No.	PRIMARY VOLTS	HTV aside	HT mA	FILAMENTS	RETAIL PRICE
PF185	240	150	30	6.3V/2A	47/9
PF299	240	285	40	6.3V/2A, 5V/2A	47/9
PF300	240	325	40	6.3V/2A, 5V/2A	49/5
PF201	240	225	50	6.3V/2A	48/7
PF151	200, 230, 240	285	60	6.3V/2A, 5V/2A	57/9
PF166	200, 230, 240	325	60	6.3V/2A, 5V/2A	58/9
PF165	200, 230, 240	385	60	6.3V/2A, 5V/2A	63/4
PF170	200, 230, 240	285	80	6.3V/2A, 6.3V/2A, 5V/2A	66/2
PF169	200, 230, 240	325	80	6.3V/2A, 6.3V/2A, 5V/2A	67/9
PF162	200, 230, 240	385	80	6.3V/2A, 6.3V/2A, 5V/2A	71/1
PF130	200, 230, 240	285	100	6.3VCT/2A, 6.3V/2A, 5V/2A	73/4
PF164	200, 230, 240	325	100	6.3VCT/2A, 6.3V/2A, 5V/2A	75/-
PF160	200, 230, 240	385	100	6.3VCT/2.5A, 6.3V/2A, 5V/2A	83/1
PF152	200, 230, 240	285	125	6.3VCT/3A, 6.3V/2A, 5V/2A	92/9
PF163	200, 230, 240	325	125	6.3VCT/2.5A, 6.3V/2A, 5V/2A	94/5
PF181	200, 230, 240	385	125	6.3VCT/3A, 6.3V/3A, 5V/2A	104/-
PF174	200, 230, 240	285	150	6.3VCT/2A, 6.3V/2A, 5V/2A	97/6
PF142	200, 230, 240	325	150	6.3VCT/2A, 6.3V/2A, 5V/3A	105/-
PF175	200, 230, 240	385	150	6.3VCT/2A, 6.3V/2A, 5V/3A	121/8
PF173	200, 230, 240	425	175	6.3VCT/3A, 6.3V/2A, 5V/3A	188/4
PF140	200, 230, 240	385	200	6.3VCT/3A, 6.3V/3A, 5V/3A	176/3
PF171	200, 230, 240	385	250	6.3VCT/4A, 6.3V/3A, 5V/3A	231/10

POWER AMP. AND LOW POWER TRANSMITTER UNITS

PF159	220, 240, 260	475	175	6.3V/4A, 6.3V/2A, 5V/3A	205/2
PF172	200, 230, 240	500	200	6.3V/4A, 6.3V/3A, 5V/3A	231/10
PF143	200, 230, 240	600	200	2.5V/5A, 2.5V/5A, 5.5V/5A	256/8
PF147	200, 230, 240, 260	1000 750 500	200 250 300	5.5V/3A	318/4
PF179	200, 230, 240	475	225	6.3VCT/4A, 6.3V/2A, 5.5V/3A	199/-

PF107	230, 240	585	250	6.3V/3A, 6.3V/2.5A, 5V/3A	244/5
PF176	200, 230, 240, 260	1250	300	5.5V/3A	488/11
PF177	200, 230, 240, 260/1830, 1100	300	300	6V/3A	Price on request

VIBRATOR AND A.C. POWER TRANSFORMERS

PF182	240AC 12V1B	200	40	12.6V/1A	58/6
PF122	240AC 6V1B	220	40	6.3V/2A	58/9
PF125	240AC 6V1B	250	60	6.3V/2A	68/6
PF126	240AC 12V1B	250	60	12.6VCT/1A	68/6
PF119	240AC 6V1B	325	125	6.3V/4A	97/8
PF146	200, 230, 240 AC, 12V, V1B	325	150	12.6VCT/2.5A	115/-

VIBRATOR TRANSFORMERS

CODE NR	PRIM. VOLTS	DC OUTPUT VOLTS	mA	BUFFER Full Sec.	RETAIL PRICE	
VT100	32	200	40	.005	48/4	
VT101	6	90	15	.008	37/11	
VT102	6	150	25	.005	44/4	
VT103	6	200	50	.005	46/8	
VT104	6	250	60	.005	47/9	
VT105	12	250	60	.005	49/5	
VT106	6	300	75	.008	78/11	
VT107	6	250	60	.005	52/3	
VT108	12	90	15	.008	39/5	
VT109	24	90	15	.008	41/8	
VT110	12	150	25	.005	46/8	
VT111	24	150	25	.005	51/1	
VT112	12	200	50	.005	48/11	
VT113	24	200	50	.005	48/11	
VT114	12	300	75	.008	85/-	
VT115	24	300	75	.008	85/10	
VT116	24	250	60	.005	54/5	
VT117	12	250	60	.005	52/9	
VT119	32	150	25	.005	44/2	
VT121	6	180	30	.005	48/11	
VT122	6	400	50	.005	79/9	
VT123	12	320	125	.005	102/8	
VT124	32	250	60	.005	53/4	
VT127	6	200	50	.005	48/11	
VT128	12	250	60	.005	57/9	
VT146	6 or 12	240AC	50W	.05	For emergency light, etc.	64/2

POWER CHOKES

CODE No.	IND. HY.	DC RES	DC mA	RETAIL PRICE
CF100	50	1900	10	32/1
CF101	30	870	25	31/3
CF102	15	300	60	24/5
CF103	30	420	60	45/10
CF104	30	580	75	48/9
CF105	15	250	80	41/1
CF106	12	200	100	41/6
CF107	30	360	100	56/3
CF108	12	135	150	58/8
CF109	20	225	150	61/3
CF110	12	100	200	71/1
CF111	16	165	200	71/1
CF112	10	70	250	71/1
CF113	.5/20	70	250 50	78/4
CF114	1.1	23	375 AC	48/9
CF115	.017	.6	2A	21/5

GRID INPUT TRANSFORMERS

CODE No.	MATCHING FROM	TO	NOM. PRIM.	IMPEDANCE SEC.	MAX. WATTS	RETAIL PRICE
MT104	Mike, P.U.	Grid	3.7, 50	50,000		48/9
MT105	Mike, P.U.	Grid	3.7, 50	60,000		178/4
MT108	Line	Grid	120	1200		107/6
MT109	Cath.	Grid	100	1000		61/1

LINE TRANSFORMERS

MT100	Line	Spkr.	600	4, 3	15	61/1
MT101	Line	Spkr.	500	15	15	61/1
MT124	Line	Spkr.	600 500	4, 3, 2.7 2.3, 2.	25	102/8
MT125	Line	Spkr.	600 500	15, 12.5 8.4, 6.5	25	100/2
MT111	Line	Spkr.	500	12.5, 8 2.3	10	65/10

MODULATION TRANSFORMERS

MT118	Audio Amp	Class C Amp	8000 6000 P.P.	10,000 7000 5000	25	161/5
MT119	Audio Amp	Class C Amp	8000 6600 3800 P.P.	10,000 7500 6500 5500 4500 3500	50	185/10
MT120	Audio Amp	Class C Amp	500 to 20,000 in steps	500 to 30,000 in steps	50	339/9
MT121	Audio Amp	Class C Amp	500 to 20,000 in steps	500 to 30,000 in steps	125	418/4

DRIVER TRANSFORMERS

MT106	Class A Driver S.E.	Class AB1 Grids	5000 Step Up 1:5 Pri. DC 40 mA	125,000	5	106/6
MT107	Class A Driver Hi. MU. S.E.	Class A Grids P.P. or S.E.	10,000 Step Up 1:3	90,000	1	155/5
MT112	Class A Driver Hi. MU. S.E.	Class A Grids P.P. or S.E.	10,000 Step Up 1:2 5 mA DC unbalance	40,000	.5	97/9
MT113	Class A Driver S.E.	Class AB2 Grids	5000 Step Down 1:25:1 40 mA Pri. Dc.	3200	2	116/3
MT114	Class A Driver P.P.	Class B Grids	5000 Step Down 1, 1.5 or 2	5000 2200 1250	5	133/3
MT115	Class A Driver P.P. or S.E.	Class B Grids	5000 Step Down 1.07 or 1.4 40mA DC max unb.	4400 2580	5	133/3

FILAMENT TRANSFORMERS

CODE No.	PRIM. VOLTS	SEC. VOLTS	RETAIL PRICE
PF117	240	2.5V/3A.	31/8
PF118	220, 240, 260	2.5V/5A, 2.5V/5A.	55/2
PF158	220, 240, 260	5V/8A.	61/1
PF138	220, 240	6.3V/4A, 5V/4A, 2.5V/4A, 2.5V/4A.	86/8
PF162	240	6.3V/3A, 6.3V/3A.	63/9
PF154	200, 230, 240	7V tap 6V/7A, 6.3V/3A, 5VCT/5A, 5V/3A, 2.5V/7A.	183/4
PF102	240	7.5V/2A.	46/5
PF111	240	10V/5A.	65/7
PF131	230, 240	10VCT/10A, 5V/15A.	195/7

ENGINEERED TO-DAY FOR TO-MORROW'S REQUIREMENTS

roughly doubles the frequency at which the peak in the response curve occurs. Hence a correction circuit which is ideal at 7.5 inches per second will accentuate the peak at 15in per second instead of reducing it.

Frequency correction networks lower the overall gain of the amplifier considerably, since they actually attenuate the middle frequencies, and this must be taken into consideration when estimating what voltage gain will be needed. An additional gain of 10 to 15 db should be adequate to cover this loss.

For maximum signal-to-noise ratio the AF level must be kept high, but it must not overload the tape or head. The optimum level can readily be found by experiment. There should be no difficulty in obtaining a useful volume range of 50 db, and with careful design even more; but in order to make the best use of the available range some form of level indicator is essential.

This need not be elaborate or even highly accurate, since only a relative indication is required. A simple output meter with a usable scale range of about 20 db is excellent.

Some commercial recorders use a cathode ray tuning indicator, such as a 6U5, arranged so that the "eye" closes at the maximum level which the tape will handle. This is very satisfactory for a general-purpose recorder and has the advantage of taking no AF power from the circuit.

BIAS SIGNAL

In theory the level indicator should be connected across the head, but in practice there is often difficulty in filtering out the bias voltage, which would give a false reading. To avoid this trouble the indicator can be connected to the grid of the final stage, which must of course be free from bias voltage, or even earlier in the circuit if necessary.

Due to the frequency correction system the level as shown by the indicator, if it is linear with frequency, will not always correspond to the reproduced level.

To give an indication of what the relative levels of treble, bass and middle will be on reproduction, rather than what they are before recording, a de-correction network is inserted between the amplifier and the indicator, with a frequency response which is the inverse of that of the amplifier and hence the same as that of the recording process and playback circuits, if the overall response of the whole system is linear.

A circuit such as that shown in Fig. 5 will serve this purpose.

The maximum recording level, as shown by the indicator, must be lower than the actual overload level by an amount approximately equal to the amount of correction or boost. Otherwise the extreme frequencies may overload the recording, although the level indicator shows no excessive reading.

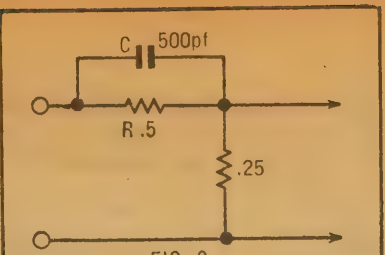


FIG. 3

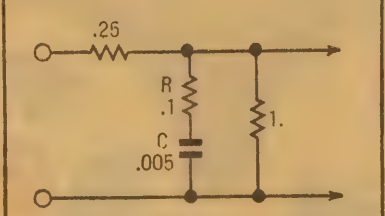


FIG. 4

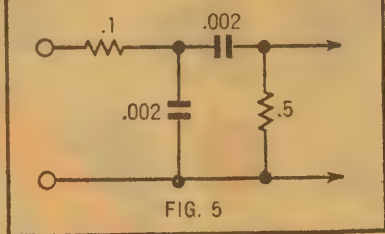


FIG. 5

Basic networks for treble and bass correction.

DC biasing, which was used fairly successfully in the early magnetic (wire) recorders and is still occasionally used, gives results so inferior to those obtained by using supersonic AC bias that it may be considered obsolete.

It was the discovery of the advantages of supersonic bias that changed the magnetic recorder from a laboratory experiment to a high-fidelity recording instrument.

Frequencies used in practice for biasing are between 25 and 50 kc/s. The exact frequency is not critical in itself, but the bias voltage across the head, and hence the flux density in the gap, may vary with frequency.

The bias generator is a straightforward power oscillator and follows standard practice. A Hartley circuit is commonly used and probably gives the best waveform while delivering a high output. Distortion of the bias waveform, particularly even-harmonic distortion, is to be avoided as far as possible.

The whole oscillator section must be well screened to prevent stray coupling with the amplifier circuits. This is apt to be troublesome if it affects high-gain, low-level stages,

where a voltage may easily be picked up big enough to overload the following stages and ruin performance.

In an experimental circuit, checks should be made at the grid of the final amplifier stage for the presence of a supersonic voltage, with the gain control at maximum and the input connections "open."

If an excessive voltage is found it may be due to parasitic oscillation; a further check with the bias oscillator off will confirm this if the voltage is still present.

Coupling between the oscillator and the head is accomplished preferably by a medium or low impedance secondary and a winding of the same impedance on the head. This method minimises interaction between bias and AF circuits and is probably the most efficient; but when a higher impedance head is used capacitance coupling also gives good results. (Fig. 6.)

TRAP CIRCUIT

The disadvantage of this latter circuit is that intermodulation takes place to a certain degree, and this upsets the bias action. To prevent this, an RF choke or parallel-tuned circuit can be inserted in series with the AF coupling capacitor.

A resistor of about 10,000 ohms may be used, but it must have an adequate wattage rating as most of the bias voltage is developed across it. The anode end may be decoupled by a capacitor of 100 pf or slightly more.

Where the recording head has a single low-impedance winding the audio output must be coupled to the head through a transformer. A standard type of speaker transformer of good quality is quite suitable.

The bias current must of course be fed from a low-impedance winding on the oscillator coil. This winding may be connected as in Fig. 7, where one side of the head is earthed.

COUPLING CONDENSERS

The coupling and other capacitors in the oscillator circuit must be high-grade mica types, as they have to deal with high voltages and considerable currents.

In designing an oscillator coil it must be remembered that it delivers up to three or four watts, and the voltages across the tuned circuit may be 500 or more. Therefore, heavy wire, at least 32 SWG, is required for the tuned winding, and an appropriate gauge for the secondary, if one is used, and the insulation must be above reproach.

The L-C constant for 30 kc/s is 28,000 with L expressed in millihenries and C in picofarads; therefore suitable values for the tuned circuit are 28 millihenries and .001 mfd.

The output voltage from a secondary can be calculated on a turns-per-volt basis by measuring across

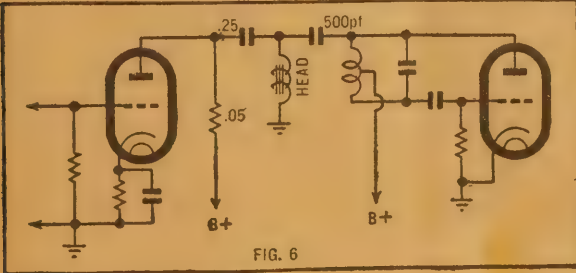


FIG. 6

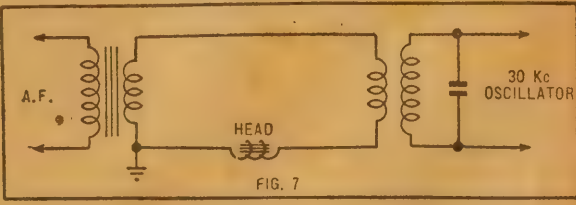
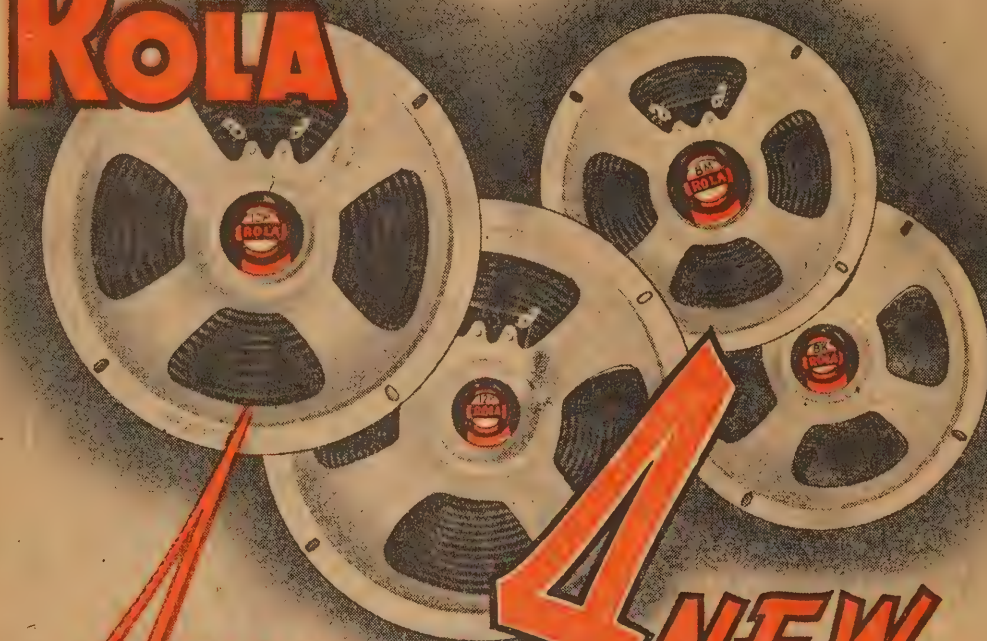


FIG. 7

Illustrating typical methods of feeding high (left) and low (right) impedance heads with bias and signal currents.

ROLA



Announces 4 NEW "FLUXMASTER" MODELS

Now readily available from all Rola distributors, these new Fluxmaster models, equipped with Rola's new centre-block magnet system, are the most efficient of their type ever to be developed. Because of their wide range and excellent transient response, they are ideally suited for use with standard receivers and amplifiers.

SPECIFICATIONS

Model	Power Handling Capacity (Watts)	Fundamental Diaphragm Resonance (C.P.S.)	Frequency Range (C.P.S.)	Voice-Coil Impedance (Ohms at 400 C.P.S.)	Air Gap Flux Density (Gausses)	Diameter of Baffle Opening (Inches)	Transformer Type	Price *
8K	5:	85 - 95	90 - 6,000	2	7,780	7	C	64.4
8M	7	85 - 95	90 - 6,000	2	9,450	7	C	76.9
12K	5:	80 - 90	85 - 5,500	2	7,780	11	C	81.5
12M	7	80 - 90	85 - 5,500	2	9,450	11	C	92.7

*With Transformer. Includes 3 1/2% Sales Tax.

the impedance required secondary of, say, 100 turns.

The voltage required across the head winding depends upon the impedance and the optimum bias current for the head, and varies from 4 or 5 volts for a low impedance to 100v or more for a high impedance winding, where a high voltage is necessary to obtain sufficient bias current.

For experimental work, or speech recording, where a slightly higher noise level is permissible, DC erase is quite satisfactory. A small permanent magnet with poles $\frac{1}{16}$ in to $\frac{1}{8}$ in apart will serve.

The edges of the poles should be rounded off slightly with an oilstone to avoid wearing the tape. However, there is no need to press or pull the tape against the poles, as it tends to be attracted to them like any other magnetic substance.

TWO MAGNETS

In any case, the field of the magnet is so large that the tape can be spaced very slightly from the poles if necessary.

A lower noise level can be achieved by using the "saturation-neutralisation" principle. This calls for two magnets. The first, in close contact with the tape, saturates the magnetic particles and so completely erases the previous modulation.

The saturated tape now moves past the second magnet, which is placed in opposite polarity to the first. This magnet is spaced slightly from the tape so that its field is just strong enough to bring the magnetic particles to neutral, giving a much lower noise level than that of a saturated tape.

The position of the second magnet is critical and must be adjusted for minimum noise level.

When playing back, the magnet must be removed from the vicinity of the tape altogether, as it can partially erase the modulation even when it is an inch or two away. For this reason the greatest care must be taken in handling the magnet, merely to touch a piece of tape with it is sufficient to erase the portion touched, and a missing word or note can spoil a recording.

Sweet are the uses of adversity, however, and this property can be put to good use in editing recordings, when an unwanted word or sentence can be removed neatly with a small permanent magnet after a little practice — which should naturally be carried out on some unimportant material first.

In a high-fidelity recorder super-sonic erase gives a better signal-to-noise ratio, and has the advantage that the erase action can be started and stopped by switching the oscillator on and off. A large gap on the erase head allows several complete cycles to act on any given point of the tape during the time which it takes to move from one pole to the other.

The source of supersonic current to feed the erase head can be the bias oscillator if it is capable of supplying enough power; alternatively, a separate amplifier can feed the erase head, driven by a small portion of the bias voltage.

A 6V6 is suitable for this stage, with its grid perhaps connected to a tapping on the oscillator grid leak. If a tuned anode load is used, this stage can be operated in class B.

Coupling between the oscillator and the head again depends upon

the impedance. If a single oscillator stage is to supply current for both bias and erase, then the bias may be capacitance-coupled from the anode (high-impedance) as in Fig. 6, and the erase head may be fed from the low or medium impedance secondary.

For the anode load of an erase amplifier, a tuned transformer wound like the oscillator coil is suitable for low-impedance heads; otherwise, capacitance-coupling can be used.

A more elaborate, but more flexible, arrangement which is particularly useful for experimental work, calls for a low-power oscillator such as a 6C5, driving one or two 6V6's, according to whether a common source or two independent sources are required.

This avoids drawing power from the oscillator, which has only to generate 20 or 30 volts to feed the power amplifiers.

The output can easily be controlled by varying this drive voltage, without upsetting the oscillator's operating conditions. The design is straight forward and follows low-power transmitter practice.

If the same head is used for both recording and playback overall monitoring is not possible. However, it is often useful to be able to monitor the audio signal at the head, to check quality, listen for cues, adjust microphone balance and for many other purposes.

In addition, this can provide an auxiliary check on level.

An unexpected change in level is noticed more quickly by ear, unless the level indicator is watched continuously; and the latter cannot tell the operator whether the change, or break in the program, is deliberate or due to a fault or accident.

For some types of recording, such as radio programs, a loudspeaker monitor is best, but there are occasions when a speaker cannot be used — as when a microphone is being used close to the equipment.

PHONE JACK

For these occasions provision must be made to use phones for monitoring, and the obvious arrangement would be to have a jack in some convenient position, which cuts out the speaker when the plug is inserted.

As in the case of the volume indicator, if the monitor follows the correction network it must be taken through a decorection filter, and in practice one filter may be used for both indicator and monitor.

Assuming that the signal is taken from the amplifier at the grid of the final stage, it will be at too low a level to operate a speaker; therefore, at least one stage of amplification will be required. A 6V6 is the logical choice to drive a speaker, and a medium-mu triode (6SJ7 triode-connected) should give plenty of voltage gain to drive the 6V6.

A volume control for the monitor channel is needed, and this can be at the grid of the 6V6, with the phone jack immediately following it.

The only special requirement of the recorder power supply is that the smoothing must be efficient to keep the hum level as low as possible. To achieve this a two-section filter is more effective than a single large choke with, say, two 16 mfd electrolytics.

In addition, it will be necessary to decouple the first, if not all, voltage amplifier stages with a 25 or 50 K resistor and an 8 mfd electrolytic.

(PART 2 — NEXT MONTH)

N. H. V. KITS

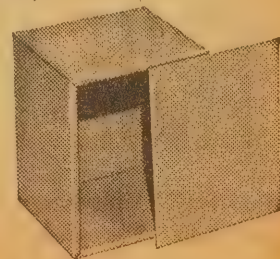
THE "TENNER"

10 Watt Amplifier
Kit £10

(plus Sales Tax).

- ★ PHONO INPUT
- ★ MIKE INPUT
- ★ TONE CONTROL

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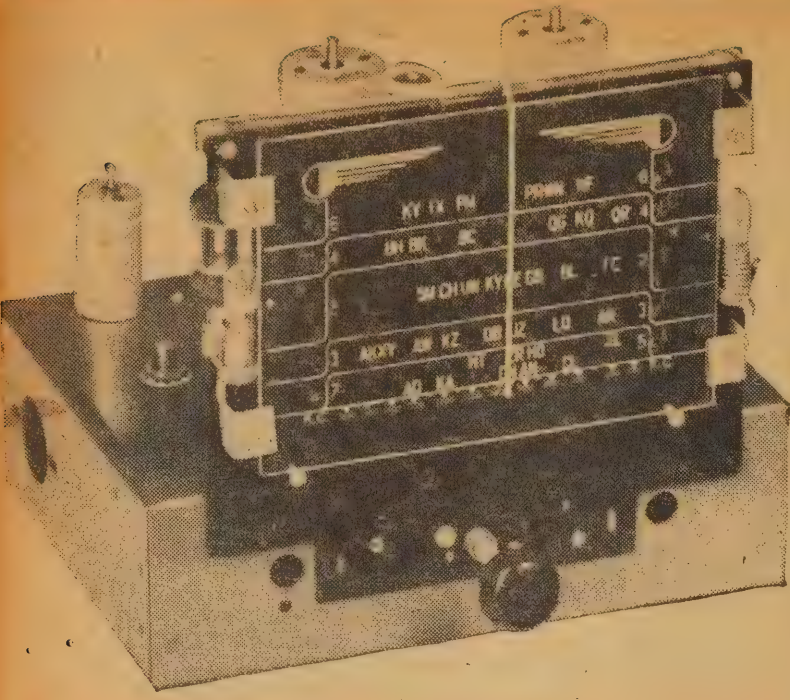
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This view illustrates the general compactness of the tuner built on a standard chassis. The audio volume from the tuner is adjustable at the amplifier control unit. Mention is made in the text of the fitting of a subsidiary volume control if desired.

ly over-coupled IF transformers and proceeded to suggest that the tuner we were looking for might well be a superhet with two 1.9 Mc wide-band transformers and coils to match.

At least one of the major coil manufacturers took us up on this prediction and set about to design just such an IF channel. It looked good immediately—very good!

But then came the snag which resulted in an urgent trunk call. The moment the tuner was provided with an aerial coil of even moderate "Q," the promising-looking selectivity curve was ruined, particularly at the low frequency end of the band. What could possibly be done about it?

BAND-PASS CIRCUIT

Our answer was immediate. Use a band-pass aerial circuit of the same type that once was featured in old-style TRF's. We reckoned that a quality fan who has spent a lot of money on an amplifier and speaker system isn't going to quibble about an extra coil and gang section.

So the kit was born, complete with a ready-wound coil for the whistle filter.

The end result is shown in the audio response curve. At the low frequency end of the band, where the main nationals are, the tuner is absolutely flat to 5 Kc, dropping by less than 1 db at 6 Kc, dropping 2½ db at 7 Kc. At 8 Kc it is down

A TRUE WIDE-BAND A.M. TUNER

Here at last is the tuner that quality fans have been waiting for all these years. It is simple to build and align, it is broad enough to admit all the audio you'll need, yet it's sharp enough to reject other stations and their heterodynes. Though designed to match the "Playmaster" equipment, you can use this tuner with any standard amplifier.

WE can say right at the outset, and without further ado, that this new tuner is far and away the best we've ever described from the point of view of quality. It's measurably better than any ordinary TRF, loaded or otherwise. And it's sensitive enough for all suburban and near-country locations. Having said that, we've said a lot.

While the general tuner position has long been appreciated, the research which led to the development of this new design really sprang from a discussion in our own laboratory and an article in the "Let's Buy An Argument" series for April last.

WHAT WE FOUND

It was demonstrated in that issue, with the aid of curves, that the traditional simple TRF fell a long way short in its ability to produce adequate signals for a wide-range amplifier system. It was better than an ordinary superhet but far from ideal.

As the curves showed, in the middle of the band, the selectivity of a straight TRF tuner, even using a diode detector, was sufficient to lop its audio response by about one decibel per Kc of audio.

Resistive loading across the tuned circuits helped a little but not enough. Loading sufficient to prevent treble loss wrecked the ability of the tuner to receive and separate all the locals cleanly.

What was more unfortunate, the pass band varied drastically with signal frequency. At the high frequency end it was quite good but, at the low frequency end, where good response is required from the main nationals, the curves showed a 10 db loss at 6 Kc and 14 db at 8 Kc.

Short of a mechanically complex band-pass system, the best proposition looked to be a superhet, in which the selectivity could be controlled and pre-set in the IF channel. We pointed out the possibilities of slight-

5 db and thereafter the curve drops steeply to a complete cut-off at 10 Kc, where the heterodyne frequency would be heard.

The curve is somewhat more rounded at the high frequency end of the band but the audio content will be much the same as far as listening is concerned.

SPECIAL COIL

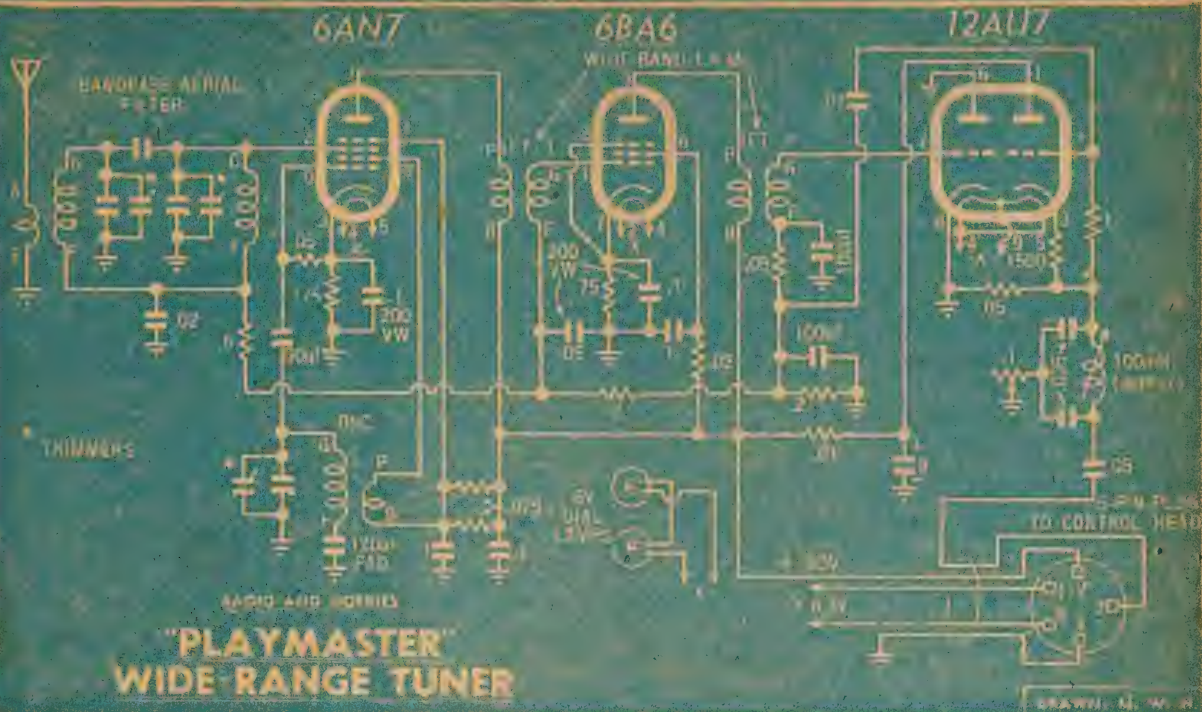
Tracing the circuit, the aerial connects to what looks like an ordinary aerial coil—at least it has the same connections. However, the inductance and "Q" are specially controlled so that it can feed appropriately into the second coil, which is housed in a separate can.

Coupling between the two is by means of 2 to 3 pf at the "top" and by a common .02 mfd at the bottom — both values being fairly critical.

The signal from the band-pass aerial circuit passes to the grid of a 6AN7 converter, which operates under quite standard electrical con-

A COMPLETELY NEW DESIGN GIVES

CIRCUIT USES 1.9mc IFTs, BAND-PASS FILTER



The value of the "top" coupling capacitance between the two tuned circuits in the Barkhausen series filter is 2 to 3 pF. Should the tuner be used with a high tension voltage approaching 250, the "2 by .025 meg" resistors connecting to the "2" pin of the 6BB7 oscillator coil should be replaced by 2 by .04 meg, 1 watt or a single .02 meg 2 watt (or the screen resistor to the 6BA6 increased from .02 meg. to .035 meg, 1 watt. Intermediate values will call for intermediate values;

ditions. No special comment is required here.

The oscillator coil, however, is a special unit designed to operate into a 1.9 Mc IF channel. An ordinary oscillator coil will not do in this position.

For the padder, a 120 pf fixed mica condenser is specified although conceivably, other manufacturers might specify a slightly different value. What ever the figure, however, for particular brands of coil, you can rest assured that it will be fairly critical value, governing as it does the accuracy of tracking.

A dial with ordinary calibrations can be used, provided it matches the gang selected.

providing a low impedance feed for the whistle filter and for the output line.

The use of a twin triode in this fashion was largely dictated by the need for separate cathodes, a feature which is not usual in ordinary diode-amplifier valves.

We have suggested that the manufacturers make available the necessary whistle filter coil and release it, together with the other coils, IF transformers and padder as a complete kit. In this way, confusion will be avoided with other more standard components.

So much for the circuit design.

Fortunately, the constructional re-

quirements fitted in with a chassis layout already available. It is the one used for the Pentagrid 4 and 5 (R & H Kits Nos. 2 and 6) of the September and December, 1950 issues. It is also used for the "All Battery Five" and the "Economy Five" sets.

EITHER SIZE

As it stands, the chassis is punched for the standard size of coil can. To fit the smaller coils for this set we simply cut a piece of metal approximately 4in by 1½in, drilled three groups of holes for the small coils and four holes for mounting to coincide with existing holes in the chassis and secured it in place.

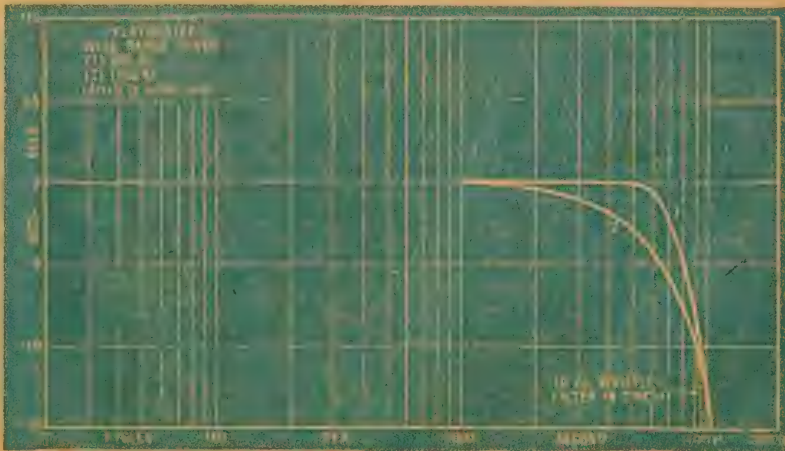
IF TRANSFORMERS

The IF transformers are fairly standard 1.9 Mc. units although slight amendments have apparently been made to their "Q" and coupling factor. They are specially marked for use in positions 1 and 2.

In association with the 6BA6 IF amplifier, the two transformers give plenty of IF gain. As we suggested earlier, it adds up to a tuner which is sensitive enough for use in any but difficult areas, where wide range reception would not be a proposition anyhow.

Output from the IF channel feeds into one section of a twin triode, which serves as a simple diode, providing detection and simple AVC.

The second section of the same valve operates as a cathode follower,



These two curves, as the initial frequency response of the laser, compared with previously published response curves of tuners will show the superiority of this design. The whistle filter begins to introduce marked attenuation at 3.5 Kc.

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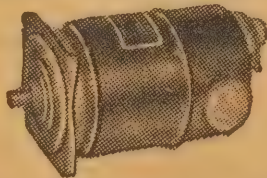
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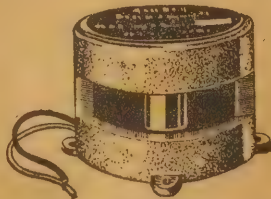
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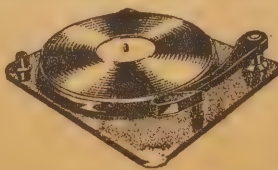
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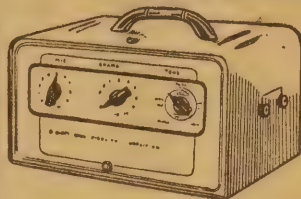
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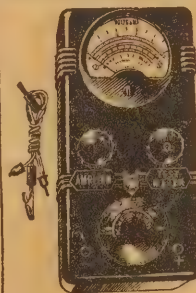


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It is preferable to use metal which will "take" solder so that some brands of small coils can be mounted securely.

When fitting the gang, use the rear bracket with its foot turned upwards. You will need to cut about $\frac{1}{4}$ in off the gang spindle to allow the dial backing plate to mount flush to the chassis front face.

It would be quite logical to mount the dial at this stage. The usual steps should be taken to remove the screw holding the dial drive drum to the backing plate, slipping it onto the gang spindle as the dial is fitted into place.

Complete the tuning assembly by soldering the trimmers into place. See that the top plate of each trimmer is the one which connects to the gang frame.

MOUNTING POSITIONS

When mounting the coils, IF's and valve sockets on the chassis, remember that there is a particular orientation for each which will permit of short leads and a tidy arrangement of the minor components.

As a guide, this is the way we did it: The two aerial coils with the grid pin toward the gang, the oscillator coil with the grid pin toward the 6AN7 socket, the 6AN7 socket with the gap between pins 1 and 9 toward the oscillator coil, the IFT1 with the HT pin toward the chassis corner, the 6BA6 socket with the gap between pins 1 and 7 toward the aerial and earth terminals, the IFT2 the same as IFT1, the 12AU7 socket with the gap between pins 1 and 9 toward the chassis rear face.

For "earth" points to the chassis, we used solder lugs under the bolt holding the coil mounting plate near the spare valve hole, under the 6AN7 socket bolt near IFT1, under IFT1 bolt near the earth terminal, under the 6BA6 socket bolt near IFT2, under the IFT 2 bolt away from the chassis rear, and under the 12AU7 socket bolt near IFT2.

Carefully scrape away the paint under the bolt head or nut in each of these positions, and, just to avoid any future trouble, connect all solder lugs together with a run of light gauge tinned copper wire.

As you can see from the under-chassis photograph, the minor components are grouped around their respective stages. With this technique, there is not a great deal of room to spare around the 6BA6 and 12AU7 sockets and consequently we have specified $\frac{1}{2}$ watt size of resistors in the parts list where applicable.

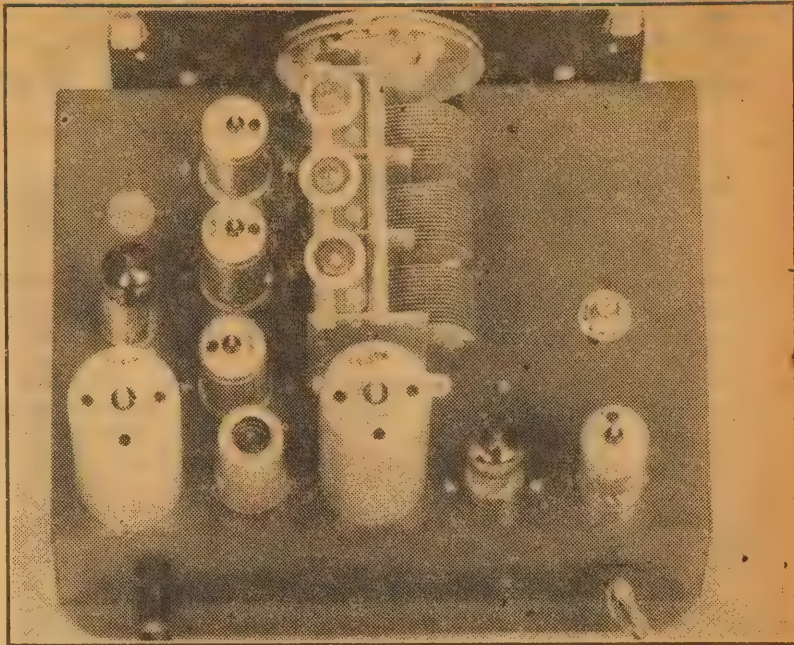
SMALLER SIZE

For the same reason we have used the small imported .1 mfd capacitors for high tension and screen bypassing, the .05 mfd for output coupling and AVC bypass and the miniature 8 mfd electrolytic for the cathode follower plate. Of course, with a little juggling, the locally manufactured type could be used in these positions.

On the gang, the first two sections tune the aerial bandpass filter and the rear, the one farthest from the dial, tunes the oscillator coil.

As the circuit diagram indicates, the amount of "top" coupling capacitance between the two aerial bandpass coils is, by necessity, quite low, about 2 to 3 pf. Make sure, there-

ABOVE AND BELOW THE CHASSIS



To the left of the coils is the 6AN7 with IFT 1 behind it. Along the rear edge to the right from the IFT 1 is the 6BA6, IFT 2, 12AU7 and the whistle filter coil with the .1 megohm potentiometer in front of it. The aerial terminal is at the bottom left with the earth terminal above it.

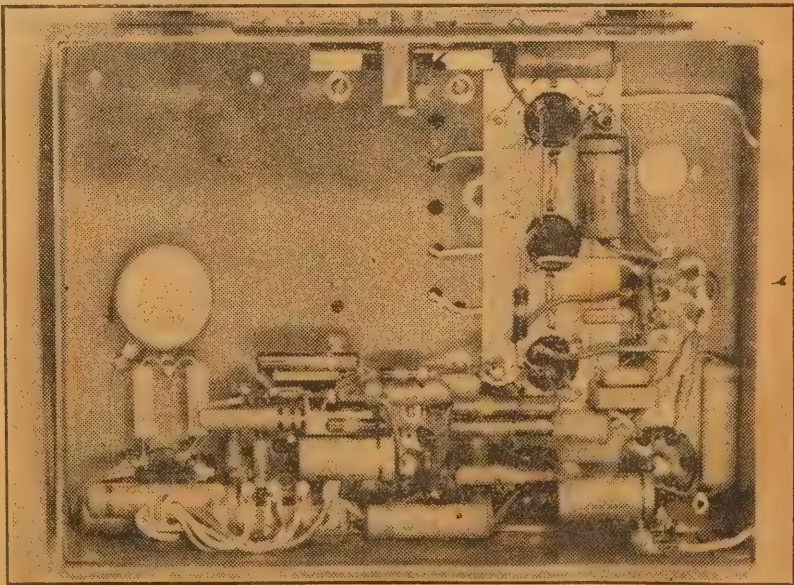
fore, that other wiring and minor components are kept away from the leads from the first two sections of the gang to these coils so that residual capacitance between them is at a minimum.

To provide the desired "top" coupling capacitance, we soldered to the "grid" pin of each of the aerial coils two short lengths of thin 7/.010 PVC insulated hook-up wire and twisted them together for a distance of about $1\frac{1}{2}$ inches. Keep this made-up capacitor away from the chassis.

Specifications for this value of capacitance may change slightly with different manufacturers and their data supplied with the coils should be consulted first.

The value of padding capacitance for the oscillator coil can be made up easily if a single capacitor is not readily procurable, simply by connecting a 100 pf and a 20pf in parallel. Low tolerance values are desirable.

The .02 mfd capacitor connecting the bridged "F" pins of the two aerial



The general layout of the wiring can be seen in this view. The only extra holes required in the chassis are for the tag mounting strips and the .1 meg. pot. The holes for the 6AN7 socket and the whistle filter coil will need enlarging slightly.

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- 1 3-section miniature gang tuning capacitor.
- 1 dial with glass to suit gang (USL 44 or similar).
- 1 set bandpass aerial filter coils, broadcast (2 coils).
- 1 broadcast oscillator coil to suit 6AN7 for 19 Mc IF.
- 2 wide band 1.9 mc IFT's Nos. 1 and 2.
- 1 10 kc whistle filter coil (approx. 100 mH).
- 2 9-pin valve sockets, 1 7-pin miniature valve socket with shield, 1 5-pin plug with cover.
- 3 gang section trimmer capacitors, standard size.

VALVES

- 1 6AN7, 1 6BA6, 1 12AU7.

CAPACITORS

- 1 8 mfd 450VV electrolytic, 3 .1 mfd 350VV, 2 .1 mfd 200 or 350VV, 1 .05 mfd 350VV, 1 .05 mfd 200 or 350VV, 1 .02 mfd, 1 .01 mfd, 2 .005 mfd mica, 1 120 pf (low tolerance), 2 100 pf, 1 50 pf.

RESISTORS

- 1 2 meg. $\frac{1}{2}$ w, 1 1 meg. $\frac{1}{2}$ w, 1 .5 meg. $\frac{1}{2}$ w, 1 .2 meg. $\frac{1}{2}$ w, 1 .1 meg. potentiometer, 1 .05 meg. lw, 2 .05 meg. $\frac{1}{2}$ w, 2 .025 meg. lw, 1 .02 meg. lw, 1 .01 meg. $\frac{1}{2}$ or lw, 1 1500 ohm $\frac{1}{2}$ w, 1 175 ohm $\frac{1}{2}$ w, 1 75 ohm $\frac{1}{2}$ w.

SUNDRIES

- 1 knob, 2 terminals (1 red, 1 black), 1 5-tag and 1 4-tag mounting strips, 1 1in threaded mounting pillar, tinned copper wire, hook-up wire, nuts, bolts, lugs, solder, &c.

coils to chassis is a design value for the bandpass circuitry and should not be substituted by another value unless the manufacturers specifications indicate otherwise.

In general, keep plate and grid leads short and tucked close to the chassis, with the exception of the two leads to the "G" pins of the two aerial coils. Note that the lead from the aerial terminal passes through a hole in the chassis side face to re-enter at a point level with the first aerial coil.

The heater wiring of the valves should be twisted together and kept close to the chassis. Neither side of this heater circuit is earthed to the chassis because the centre-tap of the heater winding on the transformer on the amplifier chassis is connected to the cathodes of the 6V6GT's to overcome any heater cathode hum in the valves in the amplifier chain.

WIRING DETAILS

The remaining minor components more or less fall into place around their respective sockets. A 4-tag mounting strip positioned about an inch from the 12AU7 socket provides all necessary tie-points for the wiring of the 1FT2 secondary and the 12AU7 stage.

From the appropriate tag on this strip, the 2 meg. AVC decoupling resistor is taken to a threaded stand-off pillar screwed on to the coil mounting plate bolt near the oscillator coil. From here the .5 meg resistor is taken to the aerial coils and a lead taken to the "F" pin of 1FT1.

The outgoing leads to the control unit of the amplifier are anchored to a 5-tag mounting strip from which the connections are made to the circuitry of the tuner. Twist together the outgoing heater wires and plait the other three leads, terminating the wires in a 5-pin plug which plugs into the control unit.

To carry out the alignment of the tuned circuits we will assume for the moment that you have on hand or can gain access to a service oscillator and output meter. Clip the meter between chassis and the outgoing audio lead or the junction of

the 2 meg and .5 meg in the AVC line. Set the service oscillator to 1.9 Mc, couple it to the grid of the 6AN7 and align the IF transformers.

Start with 1FT2 and follow with 1FT1, repeating the procedure at least once. To check that you are not being misled, give the dial knob a few turns to ensure that the IF signal which you are feeding in is not tunable.

Set the service oscillator to about 600 Kc and couple it to the aerial and earth terminals. See that the dial drum is set on the gang spindle so that the dial pointer has equal

(Continued on Page 91)

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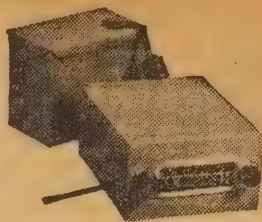
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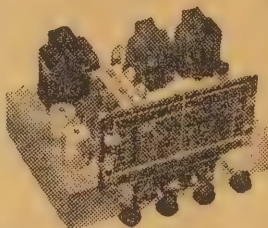
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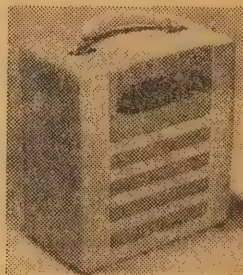
KAR-SET



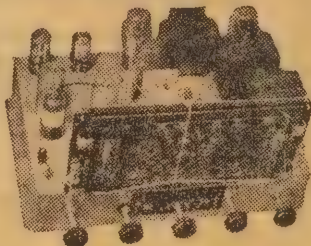
CARRY SET



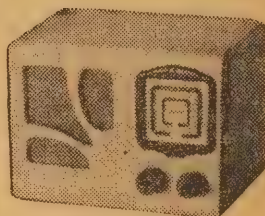
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FROM THE SERVICEMAN WHO TELLS

As I have said on a previous occasion, people who know nothing of radio invariably blame set failures on to a valve. Those who know a little more may pick on a condenser but the mentally "astute" types recite their troubles, shrug their shoulders resignedly and then explain that they can't really expect anything better, because there's an amateur four or five streets away.

BY an amateur, of course, I refer to a "ham"—not the theatrical variety, but one who owns and operates his own amateur transmitting station. You can generally tell them by the faraway looks, their untidy hair and their unkempt lawns. They are either single, or wish they still were, or are living in agreed isolation from their families. They spend their weekends erecting, climbing or lowering aerial poles.

However, be that as it may, people seem to have the impression that, because a man's backyard is festooned with aërials and beams, it must be a source of radio interference. It matters little that the woman next door spends most of the day in front of a hair dryer, that the local garage is full of arc welders, the street outside overlaid with high tension cables and the fuse box is a mass of poor connections.

Maybe I am laying it on a bit thick, but you know what I mean!

Apart from the fact that most amateurs are only on for a few evening hours at the most, their activities should not produce any trouble at all in nearby receivers, unless the receivers are obsolete or fed from an aerial hard against the amateur's transmitting array.

EASY TO PICK

When an amateur is sending speech, if he's going to interfere at all, you will almost certainly hear what he's talking about, if only in the background. It's then a matter of discussing matters with him to see whether his transmitter is at fault, or your receiver, or something else that can be fixed without too much trouble.

If the amateur transmits morse code, you might conceivably hear a series of rhythmic clicks as he sends his sequence of dots and dashes. This too, can be corrected. But it isn't hard to tell clicks of that type from the random blurts, clicks, bangs and buzzes that originate from the more usual sources of interference.

If you're clever enough, you can read the amateur's dots and dashes, but I'm darned if anyone can ever make any sense out of the other sounds. They just drive you slowly crazy.

However, to come back to actual servicing. I have a couple of tales to tell about trouble in superhet. oscillator circuits.

The first one was a standard five valve chassis, which was completely dead and, for this reason, I imagined that the fault would probably show up as a simple lack of voltage or an obvious open circuit. (How wrong one can be!)

Following the usual technique, I prodded the grid of the audio valve with my finger and produced a healthy "blurrp" in the speaker. Evi-

dently all was well in this end of the set and I moved on to the grid of the IF valve.

Touching this with the point of a screwdriver, or shorting it to chassis, produced the usual clicks and it seemed that this part of the circuit was also intact, or at least not sufficiently faulty to completely stop the set. However, when the grid of the converter valve was subject to the same treatment, there was no response of any kind, clearly indicating that the trouble lay somewhere between the two grids.

All the foregoing tests represent a more or less normal approach to any dead set, taking only a few seconds and generally enabling the faulty section to be isolated with a minimum of testing time. Next step is a more detailed check of the section thus indicated, using meters, &c., to track down the actual fault.

DETAILED CHECK

This I proceeded to do, first making a voltage check of the converter valve. Strangely enough, I could find nothing unusual, the plate, screen and bias voltages being normal, as was also the oscillator plate voltage and grid current, the latter indicating that the valve was oscillating normally.

Just to be quite sure, I checked the grid current, while temporarily shorting out the oscillator section of the gang. Each time the gang was shorted, the grid current disappeared, indicating that the circuit was indeed operating quite normally.

Nevertheless, the trouble appeared

to be around this part of the circuit, and particularly in the valve itself, for it was possible to get an indication of sensitivity when the plate was touched with a meter test prod, but absolutely nothing from the grid.

In spite of the normal readings, there was still the possibility of some obscure valve fault, so I plugged the valve into the tester. When this gave a normal reading I tried a similar valve, known to be good, in the set — and obtained exactly the same results — or lack of them.

NOT THE VALVE

This seemed to remove suspicion from the valve, in spite of the symptoms, and to indicate that the fault was really in the wiring or components associated with it. Since the ordinary voltage and current checks had failed to reveal anything, it was clear that more careful checks were necessary, and I accordingly set up the signal generator to the intermediate frequency and proceeded to test again stage by stage.

Performance was quite normal from the grid of the IF valve, while the grid of the converter was completely dead, which was what I had already experienced. The surprise came when I checked from the plate of the converter, which, according to the previous tests, should have functioned normally, but, instead, was completely dead.

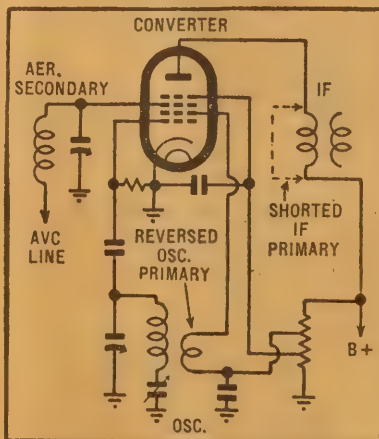
This put rather a different aspect on the fault, for the position now was that signals could be obtained from the secondary of the IF transformer, but not from the primary, making a very good case for a faulty transformer, though the exact nature of the fault was still to be determined.

PUZZLING FAULT

It certainly wasn't open circuit, as indicated by the presence of plate voltage, while it seemed improbable that the winding could be so far off tune as to completely reject a powerful generator signal, even allowing for such things as open-circuited fixed condensers or a shorter layer of turns in the bobbin.

Measuring the resistance of the secondary showed it to be about nine ohms, a fairly normal figure, but a measurement across the primary pins showed a dead short. This, then, was the answer to the rather conflicting symptoms which had initially caused me to suspect the valve. With no load in the plate circuit it was impossible for any signal to be developed, no matter what was fed into the grid, while the "click" technique had failed because the disturbances were really occurring in the HT line and being applied to other stages as well.

At the same time, the continuous DC circuit had maintained normal operating voltages on the valve, thus further clouding the issue.



Although originally in different sets, both the faults described are shown in this circuit. In the first one a faulty IF transformer caused the serviceman to scratch his head, while in the second one a faulty oscillator coil completely "bowled" a beginner with his first set.

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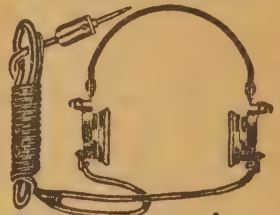
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Almost Opposite Arnold's.

I removed the can from the transformer, expecting that the fixed condenser had shorted, but I noticed immediately that the two wires from the winding concerned were crossed, being held together by the impregnating material. As soon as I separated them the short vanished and two short lengths of plastic tubing slipped over the wires ensured that it would not occur again.

This matter of poor insulation in IF transformers is one which I have mentioned on previous occasions, though all my previous experiences have been cases of breakdown between primary and secondary.

So much for that one.

HOME BUILDERS

In addition to the ordinary run of commercial sets there is always a small percentage of less conventional types, such as home building projects, which the owners either require to be aligned (and which usually burst into violent oscillation as soon as the gain comes up) or which they cannot get going and require to be checked.

The case I am about to relate was one of the latter, being, so the owner informed me, his attempt to build the Radio and Hobbies' "1946 Advance."

I learnt that it was his first attempt at a set of this size, though he had dabbled in smaller ones from time to time and felt that he had reached the stage where he could manage a "real" set.

Accordingly he had taken stock of the few parts he already had, acquired a few more from well-meaning fellow enthusiasts, and decided that they were most suitable for this particular circuit. A chassis and the remaining "bits" were then bought, and our friend set to work with enthusiasm, determined to make a 100 pc job from start to finish.

It came as something of a shock, therefore, when the set was completed and switched on to find that it would receive no signals of any kind. He poured over the circuit and the chassis in search of mistakes, but could find none, until finally, in desperation, he stripped all the wiring out and commenced the job all over again. In this way he hoped to avoid the mistake which he felt sure that he had made the first time, but which he could not find.

But it was no use; the second attempt was no better than the first, and he was thoroughly disgusted with the whole project and his own inability to follow relatively simple instructions. Having very little in the way of test gear, he was at a distinct disadvantage, but he made some attempt at servicing by substituting such valves as he could borrow from friends, but again without success.

A TRIER!

Still convinced that there was a fault in his wiring, and determined not to be beaten, he once again stripped the wiring out and proceeded to do the job for the third time—only to finish up with exactly the same results as before. It was the last straw, and, thoroughly disheartened and disappointed, he brought the set to me.

Considering that he had wired it three times, it was a remarkably neat job, though he pointed out that it was much neater the first time, which must have meant a pretty good job. Anyway, a preliminary check on the wiring showed no obvious mistakes,

so I connected a meter across the HT line and switched on. Everything appeared to proceed normally, and the HT voltage settled down to about 250 volts.

Again using the click technique, I checked, in turn, the audio section, the IF channel, the converter, and the aerial tuned circuit right up to the aerial terminal, obtaining indications of sensitivity at all points. When connected to an aerial, there was quite a healthy noise level, static, &c., but no signals, all of which pointed to a failure of the local oscillator, and I accordingly commenced a more detailed check on this section.

A meter check showed normal voltage on the oscillator plate, but no sign of grid current, clearly indicating, as I suspected, that the oscillator was not working. A continuity check showed that the oscillator secondary winding was intact and also that the grid resistor was of correct value. After checking the padder and oscillator trimmer for possible short-circuits, and remembering that the converter had been checked by substitution of a known good valve, there was not a great deal left to suspect, except the coupling condenser and the oscillator coil.

THE COIL?

Actually, there was not a great deal that one could suspect about the oscillator coil, for its windings were intact and it was certainly correctly wired. Nevertheless, I had a hunch about it, and, partly because the grid condenser was not easily reached, I decided to try my hunch first.

This consisted of simply reversing the connections to the primary winding, the assumption being that, if the fault was in the coil, incorrect base connection was about the only thing it could be. Sure enough, this was all that was required to put the set into operating condition and, although obviously in need of alignment, it immediately tuned in all the locals at good strength.

When it finally was correctly aligned the performance was really good and the owner was delighted with the results. What gave him even more satisfaction, however, was the fact that his efforts at home

construction had produced something worth while and that he was hardly to blame because the set did not work.

The point about all this is that the fault was not the constructor's, for he had followed the circuit exactly and had wired the chassis in a manner which would have done credit to a more experienced person, but rather it must be placed to the discredit of the coil manufacturer.

I suppose it is easy enough for a process worker, who doesn't know what it is all about, anyway, to transpose a couple of leads when the monotony of his (or her) job becomes unbearable, but it doesn't say much for the checking system which allows such a mistake to slip through.

NEED FOR CHECKING

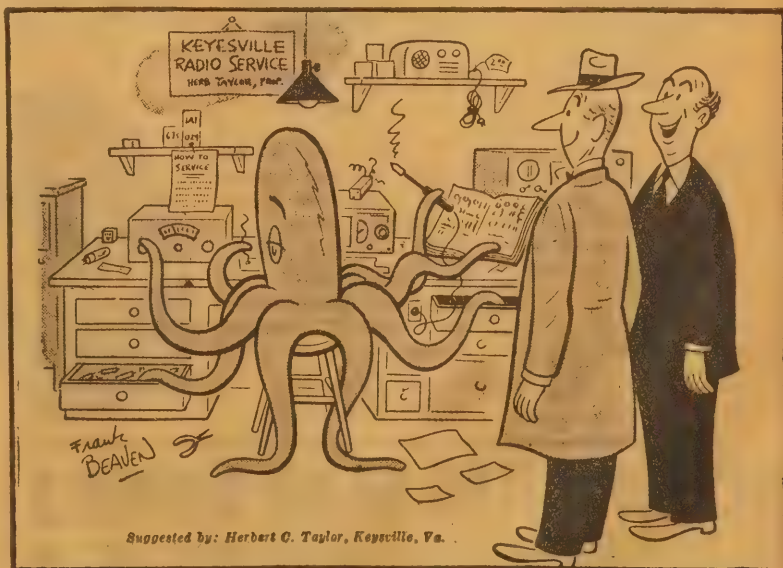
While it might be argued that such mistakes are rare, I must point out that my hunch was not born of pure guesswork, but rather of previous experience, for this is by no means the first of such cases which have come to my notice. Nor is it likely that I am the only one to experience them, thus indicating that quite a fair proportion of coils are never properly checked.

Furthermore, it appears that this kind of trouble is not confined to one maker for I have known brands other than the one I had just fixed which had suffered from the same trouble. On one occasion, so a local wholesaler tells me, a whole batch of such coils were distributed, with disastrous results in the ranks of home builders.

Since the customer pays for such checking in the price of the component, it seems hardly fair when he doesn't get it, particularly when, as in this case, it can cause so much loss of time looking for non-existent wiring faults, to say nothing of the disappointment and loss of pride of achievement, for it's never quite the same when the set has to be handed over to someone else to get going.

Perhaps this plea may catch the eye of some of our coil manufacturers and result in better checking of future batches.

Anyway, here's hoping!



Suggested by: Herbert C. Taylor, Keyesville, Va.

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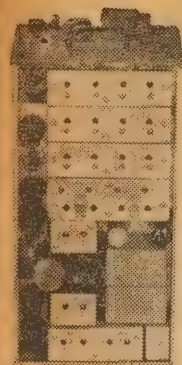
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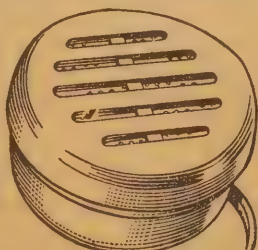
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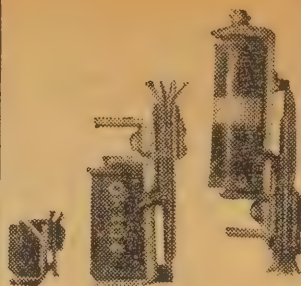
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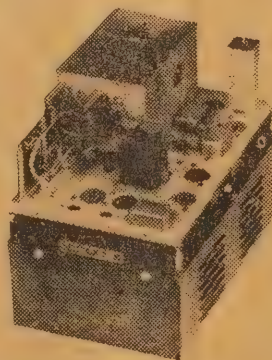
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A COURSE IN TELEVISION

(Continued from Page 33)

fields of standard line interlace and two of "dot interlace" wherein dot elements of the third and fourth fields fall midway between dots of the first and second fields, respectively. By this means, all elements of the picture are scanned in each color 15 times per second.

As in the previously described systems, this method reverses the transmitting procedure for receiving. One way of achieving this is to use three picture tubes, each viewed through a separate color filter and superimposed with a dichroic mirror. The color dot information is then electronically switched to the proper color tube for reproduction. The color sampling circuit at the receiver is synchronised with that at the transmitter.

Since the use of three cathode ray tubes for color reproduction is both costly and cumbersome, much effort is being expended on the development of a single tube capable of three-color reproduction. Several such tubes have been successfully demonstrated, the principle of one early type being shown in Fig. 6.

The screen is made up of 600,000 dots of colored phosphors, 200,000 each of red, green and blue. A perforated metal screen is arranged between the phosphors and three separate electron guns in such a manner that each gun excites dots of only one color.

The advantages of the dot sequential system are compatibility and high definition. Its disadvantages are complexity, higher cost for con-

version, and the fact that the high sampling rate of 3.6 megacycles per second prevents its use with some existing cable facilities.

However, by and large, engineers appear to favor the dot sequential system in principle and rapid advances are being made in overcoming some of its inherent problems.

This research has led to suggestions for means of achieving compatible, dot-sequential television different from those adopted in earlier experiments.

More will be said of these systems in special articles at a later date.

ANSWER TOM

(Continued from Page 35)

comes saturated and the value of the inductance drops.

When the inductance value of the choke drops, the condenser at the load end of the choke tends to make its presence felt in the same way as in a condenser input filter, with the result that the voltage tends to rise. By

properly proportioning the characteristics of the choke and the condenser, it is possible to design a power supply with almost perfect regulation up to its maximum rated current drain.

What is the meaning of the suffix letters "G," "GT," and "GT/G" after a valve title? For example, I have seen type 6V6, 6V6-G, 6V6-GT and 6V6-GT/G. Do these valves have any special electrical differences?

The suffix letters are an abbreviation for the words "glass" and "tubular" and they are used particularly with octal-based valves.

It is standard practice to omit the suffix to indicate a metal envelope. A "G" indicates a standard glass envelope, while a "GT" indicates a small glass envelope. The "GT/G" generally indicates the small envelope, the final "G" being a reminder that the valve may replace either type.

In general, all may be regarded as electrically identical. The metal type has slightly different interelectrode capacities to the glass types and it is necessary to earth the shell via pin 1.

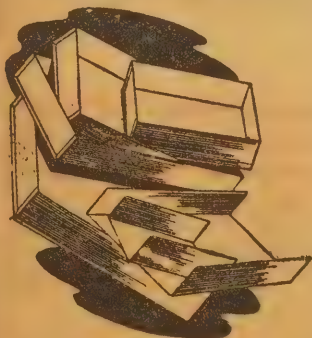
A slight amount of retuning may be necessary when the valve is operated as an amplifier at high frequencies, but this is not likely to be a problem.

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Chassis made to special sizes approx. 50% more. Post free.

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Station name Transfers. (All Australian stations, 4in.) 3/-, Rola 3" Speaker with Transformer, 40/8

Jabel Terminals, 1/3, post free.
Walnut veneer, rounded end, cabinets, make handsome Crystal sets, unpolished approximately 10in x 7in x 3in, 7/6, post free.

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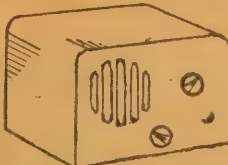


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That doesn't prove anybody right or wrong. Of course, there are good 78's and bad microgrooves, too!

My attitude, rather, is based on the premise that, by and large, the quality obtained from ordinary 78 rpm records is inadequate for modern wide-range equipment. Microgroove records are a distinct improvement.

This is (and always has been) an overall assertion, taking in good and bad, old and new, available pickups and any other factors you might think of. I fancy that there's a lot of other folk who've formed the same opinion.

These same people seem to have found a use for the filters we've described and—like ourselves—don't find them so necessary on microgrooves.

OTHER PLACES TOO!

Of course, if the pickup referred to by our two correspondents does indeed reverse the position and eliminate all the troubles we've been worried about, then it's a mighty fine effort. When all the local enthusiasts have been duly convinced and supplied, we can withdraw our "utterot" filter designs, as being of no further use.

After that, there's a pretty fair market to be tackled overseas, because I notice that quite a few concerns in England and the US are advertising filters along lines similar to the R & H efforts.

But, before we go any farther,

Let's Buy An Argument

If a couple of readers have their way, there will shortly be a drastic re-arrangement of staff in the "Radio and Hobbies" office. This would, in fact, be my last appearance as Technical Editor, all future activities being confined to the more mechanical aspects of magazine production. If you want to know what it's all about, read the letter opposite.

WHILE I hesitate to bring other names into the discussion, it must be assumed that Mr. Moyle will be similarly affected, since he has been guilty of much the same misdemeanor—inferring that 78 rpm records had their limitations.

Come to think of it, quite an array of ex-technical personnel may end up behind the ink-stained aprons.

I won't be the least bit surprised to find myself working alongside no less a person than G. F. Dutton, PhD, DIC, AMIEE, of the EML Engineering Development Ltd. He was responsible for some rather unflattering curves reprinted in the September, '51, issue, and an implied preference for the 45 rpm microgroove standard.

Still, it'll be nice to sit and yarn about old times—to dream of things that might have been.

Of course, there's still a vague chance that our remarks have not been correctly interpreted, or that some of the things we said have contained just a tiny vestige of truth.

For example, I don't remember having said (or even inferred) that

any microgroove is better than any 78 in respect to response, distortion and noise.

On the contrary, I've heard some pretty poor microgroove efforts, released with an eye to the catalogue rather than technical nicety. Notable examples are those dubbed from existing 78's, and which thereby contain a double dose of distortion.

Contrariwise, I've heard some 78 pressings on special materials, which have been really "out of the box," with excellent frequency response, a minimum of distortion and virtually no background noise.

It isn't sufficient, therefore, just to pick and choose a few special cases.

we'd better get a few ideas straight about the three predominant characteristics—noise, frequency response and distortion.

In the first place, record noise isn't primarily a function of the pickup or the record speed at all. Rather is it overwhelmingly dependent on the medium from which the pressing is made.

Now, the vast majority of 78 rpm records are pressed from shellac-based material, the advantages of which are relative cheapness, ease of working and toughness. This latter quality is of vital importance, because so many 78 records are still played with heavy pickups and even with acoustic heads.

The earlier 78 records are supposed to have contained abrasives as a measure of self-protection, but, in any case, mineral fillers are still necessary to preserve the dimensional stability of the finished disc. These "foreign" materials are largely responsible for the familiar background noise.

If the same materials were used for microgroove discs, they, too,

by **W. N.
Williams**

would exhibit a high noise characteristic.

In practice, however, microgroove discs are almost invariably pressed in unfilled vinyl. This is practical:

(1) Because they are only played with electric pickups of light weight and high compliance, and

(2) The unit value of a disc is so much higher in relation to the quantity of material used, that a more expensive medium and a more tedious process is feasible.

Last, but not least, it is standard practice on the microgrooves to pre-emphasize the treble during recording and to play back with the appropriate de-emphasis. What this can do to noise level is nobody's business.

So there it is. So long as these fundamental differences exist between the two classes of record (and they do, whether we like it or not), so long will there be fundamental reasons why one class should be more noisy than the other. I don't think there's anything silly in that statement.

RESONANCE PEAKS

The influence of resonance peaks on the residual noise level—a subject which yours truly has thrashed at great length—is very important but still a second order consideration.

Then there's the matter of frequency response, Messrs. Page and Fields mentioning a reference figure of 23,000 cps, and a maximum variation of 2 db. That again is fine, but it's only the beginning of the story.

During the past couple of years, Mr. Moyle and I, between us, have worn out half a dozen frequency records, testing pick-ups of all shapes and sizes. We've checked output, watched wave-form, observed peaks and seen several of them lift 20 Kc off the grooves—and that's too high for either of us to hear.

But—and it's a very big "but"—it isn't an accident that the 20 Kc groove is right on the outer edge of the disc where the lineal groove speed is highest. Try to record and reproduce the same frequency in near the label and you'd really be battling.

The 20 Kc groove is excellent as a means of indicating possible pick-up performance but it hardly warrants the assumption that such frequencies are available at any diameter on any good orchestral disc, let alone on the poorer ones.

PICKUPS VARY

It is true that pick-ups vary greatly in the matter of frequency response. Some are very poor, others very good. It is self-evident, however, that even the best cutter and pick-up cannot handle extreme frequencies in a groove which is travelling so slowly that the resulting wave-lengths are comparable in dimension with the stylus points.

In actual fact, it's very hard to determine just what the frequency range of an orchestral disc really is. You can get some idea with one of the accursed R & H filters, by closing it down in steps until there is a perceptible loss in treble, as opposed to a mere alteration in scratch content.

My observations, on wide-range equipment, put the useable limit of the AVERAGE 78 rpm a long way below 20 Kc. As a matter of fact, broadcasting engineers (including

(Continued on Page 63)

WANTED—A NEW TECHNICAL EDITOR!

Dear Sir,

After reading several of your articles on 78 rpm playing, we have come to the conclusion that you would be of more value to Radio and Hobbies as a linotyper, providing something was done to prevent your ideas from sneaking into print via the printing room.

On several occasions we have definitely proved wrong some of your statements, re fidelity, frequency, response, etc on 78 rpm discs.

We have found that exceptionally good results can be produced from the above mentioned, bettering, in a lot of cases, microgroove. Recently a pickup was obtained which has a proven frequency response of from 20 to 23,000 cycles per second, being flat within $\pm$ or $-$ 2db.

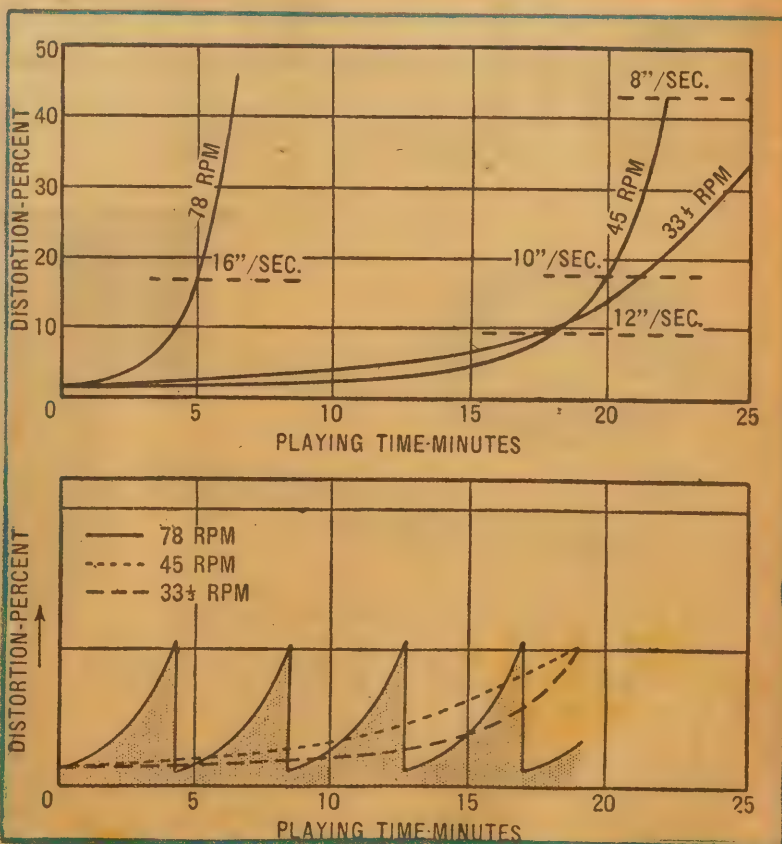
This pickup is virtually, we repeat virtually, distortionless, being, by the way, xtal, giving an output of approximately five volts. In conjunction with a modified Williamson amplifier, utilising 2A3's and an axiom 150 speaker, it gives exceptionally outstanding results, especially as was said above, on 78 rpm discs.

Surface from disc is practically negligible. Distortion, caused by pinch effect and others, does not exist. Top cut filters and other such "utter rot" were found quite unnecessary.

Hoping you will enjoy your new job,

Yours faithfully,
(KENNETH I. PAGE)
(ROBERT W. FIELDS)

What do you think of ordinary 78 rpm records, our ideas on filters and results from microgrooves? Have we the wrong slant on the whole subject?



The top curve (other bottom) illustrates the fundamental groove distortion to be expected from 78, 45 and 33 rpm records under certain presumed conditions. Lower graph relates the distortion from several 78 sides or one microgroove side for a 20-minute playing time. Modern techniques and pre-emphasis would make the microgroove look much better than the curve suggests.



You can't sell him another set yet ...!

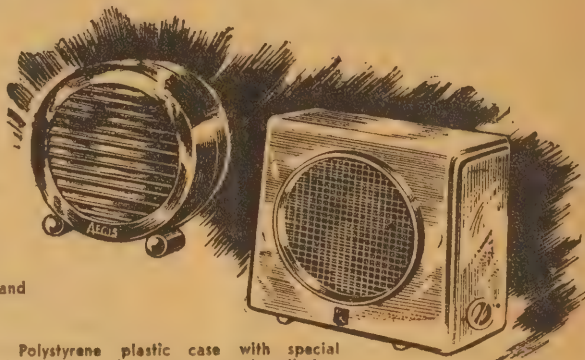
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those from the ABC and PMG) set their filters to cut off at around 6 Kc, on the assumption that they can't rely on clean reproduction from ordinary records above that limit.

And they're not restricted to "five quid" pick-ups, either, as is the average home listener.

But what of microgroove? Is it any better in this respect?

Fundamentally, the point diameter, groove dimensions and lineal speed are all scaled down by much the same ratio so that, at a given diameter, there need not be a great deal to choose between the two.

However, because of the much finer groove pitch, the use of automatic pitch control and so on, the microgroove recording is concentrated for a greater proportion of the time near the outer edge of the disc. Provided the urge for "long playing" is not carried to excess, a wider and more consistent range of frequencies can be recorded.

The process is aided further by the pre-emphasised treble technique.

THE WAY THINGS ARE

In other words, the advantages which lie with microgroove, in the matter of high frequency response, are based partly on the physical dimensions of the system and partly on recording techniques and equipment which have not, for the most part, been applied to 78 rpm pressings.

But, once again, our whole attitude to 78 rpm records and our suggestions about filters &c. have not been based on things that might have been but simply on conditions as we find them.

The same physical dimensions which limit treble response also set an ultimate limit to overall distortion. Even assuming that the pick-up translates mechanical movement into electrical voltage with complete fidelity, an ultimate limit is reached in the frequency/groove-speed relationship when you simply cannot cut and track a groove with stylii of finite size.

G. F. Dutton makes this point in the paper I referred to earlier and proceeds to develop a whole series of curves which attempt to correlate groove dimensions, lineal groove speed, playing time and the onset of distortion from fundamental causes.

ONLY APPROXIMATE

Such curves can only have a rather hypothetical basis at best, because it is very difficult to say how much distortion is "objectionable" and then to translate it into definite electrical or mathematical values.

Then again, playing time is a dubious quantity against which to plot the assumed value of distortion, because the fundamental relationship is to groove speed. For 78 rpm records, playing time is a fairly constant value, but for microgrooves the relationship between groove speed, groove diameter and playing time is quite loose.

However, Dutton was aware of all this and made an obvious attempt to write into his formulas those figures and quantities which allowed some basis of comparison between the three most popular standards.

From one set of curves I've extracted a plot which gives at least some idea of the comparative distortion over the duration of a musi-

A LITTLE COMFORT

Dear Sirs,—Please convey to Mr. W. N. Williams my sincere regards, not only for his excellent technical ability, but also as a man.

He is my pet radio technician, he appears to have a real brain and uses it. Would you please ask him to write something about leakage inductance in output transformers.

Good luck to all Radio and Hobbies staff and congrats. to Mr. Moyle. Yours sincerely, T.P.D. (Brisbane).

NEGATIVE FEEDBACK

Dear Sir,—I have been interested in your article, Let's Buy An

cal work occupying one 12in microgroove or several 12in 78 rpm sides. You can see for yourself how the systems compare and how attractive the 45 rpm standard looks for playing times up to around the 20-minute mark.

Actually, I think, the curves make microgrooves to show up much less favorably than they do in practice. Whereas the 78 standard has been rigidly adhered to, as far as this country is concerned, the tendency in microgroove is to squeeze the grooves even more than suggested in Dutton's article, with the result that the playing time scale is extended and the distortion curves are flattened out.

There are just a couple of other points which might be worth considering.

The first is the influence which the base material has on the faithfulness of the finished pressing. From past observation of 78 discs, using both shellac and vinylite, my impression has been that the vinylite has always been more free from groove distortion—this quite apart from noise.

DEBATEABLE POINTS

* Against this, it may be contended that the much finer patterns of a microgroove disc are more sensitive to mechanical stress and instability during processing.

One effect may cancel the other or it may be that microgrooves are benefiting from the fact that plenty of them stem from new recording techniques, new tape masters, new presses and an overall "new broom sweeps clean" approach.

Of course, the de-emphasis must kill a lot of distortion, too—perhaps a good deal more than pre-emphasis puts in. I'm openly speculating.

One thing I will say. There's every indication that it's a lot easier to make a good domestic standard pick-up than a good domestic microgroove equivalent. I'm speaking now, of course, of medium-priced mass-produced efforts, not samples, prototypes, or hand-made units.

The trouble with microgroove pick-ups is that it's extremely difficult to get the stylus resonance high enough to be out of the way. Mostly it ends up in the 6 to 8 Kc. region and that means throwing away some of the inherent low-noise qualities of the disc.

It might even be—and I say this with hushed breath—that the simplest

Argument in the magazine, Radio and Hobbies, and have just been reading the April, 1952, edition.

I noted with interest the varying response curves related to selectivity and the conclusion that superhets were probably capable of better results than the TRF circuits.

I also noted that while mention was made of regeneration, no mention was made of negative feedback. If negative feedback flattens the response curve of an audio amplifier one would expect that it may broaden the selectivity curve of an IF amplifier. I think it would be interesting to see curves showing the response under these conditions.—Yours faithfully, F.E.P.H. (Gilgandra, NSW).

approach for the quality enthusiast will be to use a good, well-damped crystal pickup and "go to town" with trap circuits and equalisation rather than fiddle with magnetic pickups which are mechanically sloppy.

Still, that's another story.

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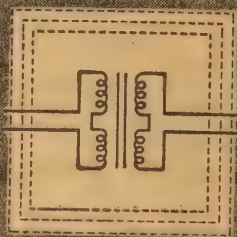
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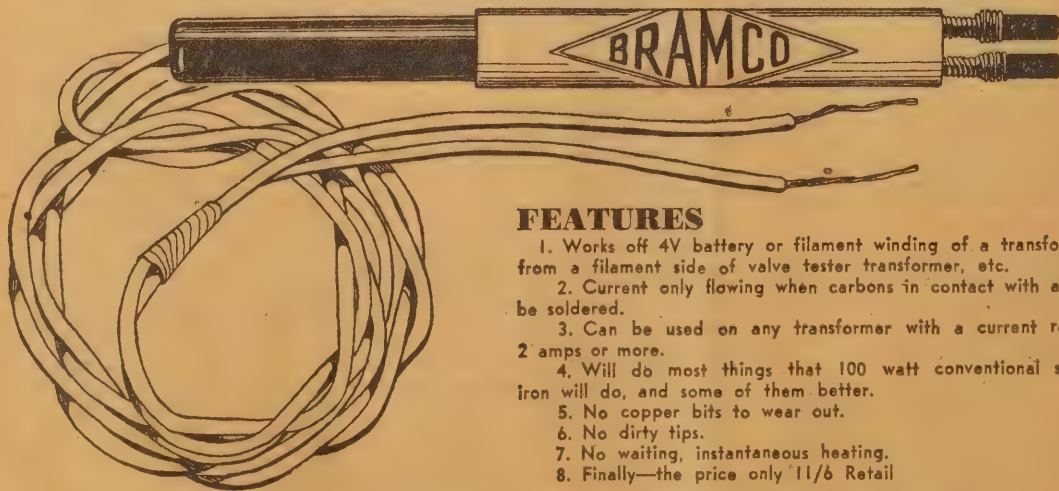
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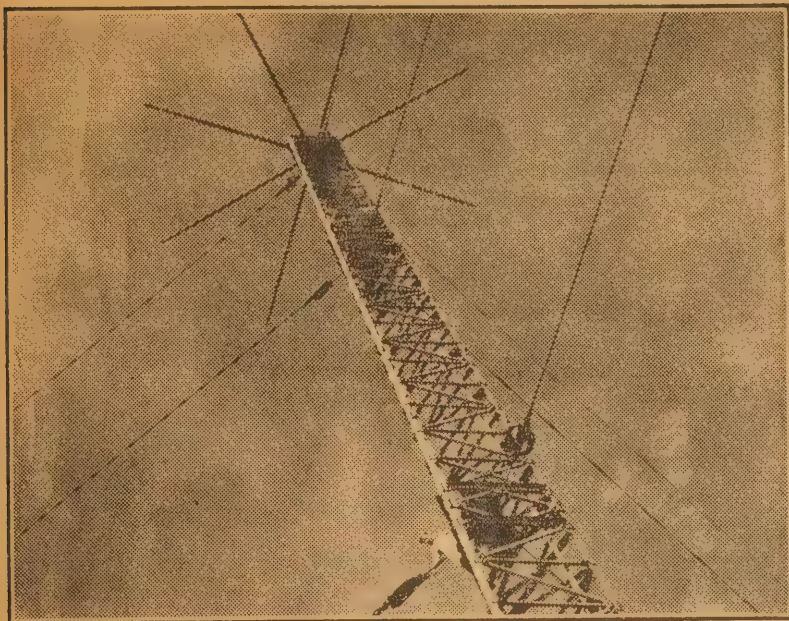
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but you can't see the energy which is being radiated because it does not have any observable effect on any one of your five senses. Therefore, it is easy to explain radiation by using the analogy of the pond of water which is something you can see.

For the transmitting aerial we substitute a piece of wood in the analogy and for the transmitter a reciprocating crank. The block of wood is connected to the crank and moves up and down with it, creating ripples on the surface of the pond. These ripples spread out in ever-widening circles all around the block of wood.

COLLECTING ENERGY

The ripples can be compared to the radio waves radiated by the aerial. If we place a second block of wood in the pond at some distance from the original one, it will be seen to bob up and down. In fact, some of the energy from the ripples can be collected and converted back into a rotary motion by means of a second crank.

In the case of radio, we have a receiver which intercepts some of the energy of the waves and converts it into a form which our ears can interpret.

Obviously since the second block

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MOST people are fascinated by a mystery and for most people radio is one big mystery. This is probably because the everyday experience of things we see, hear and feel gives us little clue to how radio works.

Most of the phenomena of electricity and radio do not affect our senses directly. We can see an express train speeding along a railway track, but we cannot see electricity flowing in a wire nor can we see radio waves radiating from the aerial of a radio transmitter. However, we can understand very easily about such things as water flowing in pipes and most of us have observed ever widening ripples when a stone is thrown into a smooth pond of water.

FAMILIAR IDEAS

Because radio and electrical phenomena are away from the experience of most people, it is easier to explain many of them by comparison with things we can observe directly and so you will frequently read of comparisons between water flowing in pipes and electric current flowing in wires.

Make no mistake! Electricity does not flow in wires exactly as water flows in pipes. However, the comparison can be made, and, before explaining the behavior of electricity in purely electrical terms, it is easier to talk in terms of things already understood until a complete picture of what happens is built up.

In explaining radio, therefore, we will make frequent comparison with mechanical phenomena, but only to build up in your mind a series of ideas so that eventually you will understand radio without a need to depend on the analogies.

The first of the mysteries is that of radiation. You may have stood looking up at a tall transmitting mast,

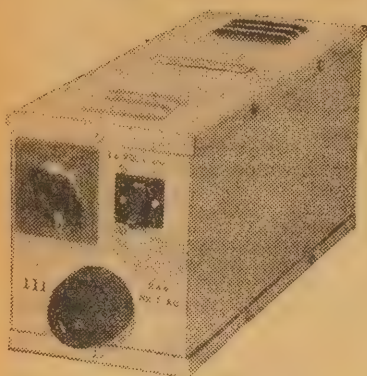
of wood, or the radio receiver as the case may be, only intercepts a small part of the original energy, a good deal of it will be wasted. Of course you could have a large number of these blocks of wood so that you could recover a large part of the original energy. It all depends on how much trouble you are prepared to take. With this system it would be possible to arrange a code to send messages from one side of the pond to the other. Of course, you would eventually find that the ripples at the far end were too weak to detect or perhaps too weak to be noticed among the random ripples caused by the wind, &c.

To extend the range you could install a larger engine and a larger block of wood to make bigger ripples. Alternatively, you could construct more sensitive apparatus for detecting the ripples. By careful improvement of both the transmitting and receiving apparatus you could extend the range from what may have been a few feet initially, to hundreds of yards.

It is just the same with radio communication. When Hertz, the Ger-

by Maurice
Findlay

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man scientist, first experimented with radio waves he was only able to demonstrate their effect over a few feet but it was only a few years before Marconi and other clever engineers were able to improve on the scientists's idea and send messages for hundreds of miles and later around the earth.

The waves radiated by a radio transmitter aren't up and down movements of the air or anything of the sort but rather electromagnetic waves which do not require air or any other material medium for their propagation. You are already familiar with other types of electromagnetic waves which affect our senses directly, namely heat waves and light waves.

Well, radio waves are of the same type as heat and light waves but their rate of vibration, or oscillation, is different which gives them some different characteristics.

Fig. 2 shows the relationship between radio waves, heat waves and light waves. Light and heat waves have specially valuable properties and, if it were not for the fact that these rays are radiated by the sun and some of them intercepted by the earth, life here would be very different or perhaps would not exist at all.

SUN AND STARS

Radio waves as well as light waves are actually generated by the sun. Some of the stars generate radio waves and with suitable receiving apparatus it is possible to detect them.

The property of radio waves of being able to travel great distances is exceedingly valuable as a means of communication. They have different properties according to their frequency, some giving good results over long distances and some being more suited for short distances.

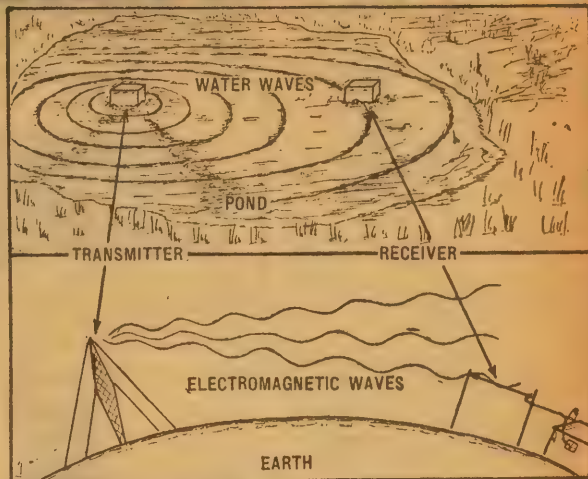
As you have probably noticed, there are often two or more frequency bands incorporated in many radio receivers. One is adjusted to receive stations which operate on a frequency which is suitable for short distance broadcasting while others are adjusted to receive stations operating on frequencies suitable for long distance broadcasting.

The full range of frequencies suitable for broadcasting is very wide and you would need to have many receivers to be able to receive them all. Fortunately this is not often necessary. For a start, you will find that there is plenty to interest you in a study of how to receive signals on the band of frequencies which is used for broadcasting over a few hundred miles.

Later, perhaps, you will also be interested in the higher frequencies (or short waves) which are used for

WATER RIPPLES AND RADIO WAVES

Fig 1: Radio waves spread out from a transmitting aerial in something the same way as ripples in a pond. However, the radio waves do not require air, or any other material medium that we know of, for their propagation so that they can travel between planets if necessary.



broadcasting over vast distances.

Before you can undertake any experiments with transmitters, it is necessary for you to have a certain minimum knowledge of the subject so that you will know how to operate the transmitter in such a way that it will not interfere with other stations which may be concerned with the safety of a ship or an aircraft, for instance.

Special frequencies are set aside for people who wish to experiment with transmitters and, if you convince the authorities that you have a sufficient understanding of the subject, you may be granted a licence for an experimental station to be operated within such a band of frequencies.

WON'T NEED LICENCE

Fortunately, it is not necessary to have any special licences to carry out experiments with receivers. The broadcast listener's licence, which covers other receivers in the same house, also covers any receivers that you may wish to experiment with.

The broadcast engineer has already taken care of the most difficult part of the job, so that it is all set for you to work out a way of receiving the signals in such a way that they can be understood.

As a matter of fact, receiving radio waves is a very easy matter. It is the job of turning them into a form which can be heard and understood that is more difficult.

Any length of wire suspended up in the air clear of other objects will intercept some of the electromagnetic waves from hundreds and perhaps thousands of radio stations. As

the electromagnetic waves intercept the aerial, electric currents will be induced in it.

The amount of current induced from transmitters a long way away will be very small indeed and may have to be amplified many millions of times before it is sufficiently strong to operate a loudspeaker or a pair of headphones. However, stations in the vicinity of the aerial may induce currents of sufficient strength to operate a pair of headphones, and in fact they do, provided the station is situated within a radius of about 15 miles.

A headphone is a device for converting feeble electric currents into audible sound. A loudspeaker does much the same job except that it requires a much greater amount of electrical energy and can produce a much greater volume of sound.

Then, why not connect the headphones to the aerial direct and listen to the broadcasting stations. There are two reasons why it is not possible to do this and we will investigate each in turn.

ACTUAL FREQUENCIES

First, the currents induced in the aerial from the broadcast station may have a frequency of anything between 550,000 and 1,600,000 cycles per second. It is not possible to make headphones which will respond to impulses at this frequency and even if it were, our ears are not capable of hearing them. The highest frequency our ears can hear is about 15,000 cycles per second.

Before we go on to understand more about the problem of receiving the signal we will say something about what happens at the transmitter.

The transmitting engineer makes use of the properties of the radio waves to travel over great distances but on its own this is of limited value. His ultimate aim is to transmit speech, music, &c., along with the carrier wave.

When we speak, or a musical instrument sounds a note, the air around the source of the sound is disturbed. The effect is something the same as in the case of the block of wood vibrating up and down in the pond of water except that the block of wood is replaced by a vocal cord or the string of the musical instrument. Instead of waves in water the string of the musical in-

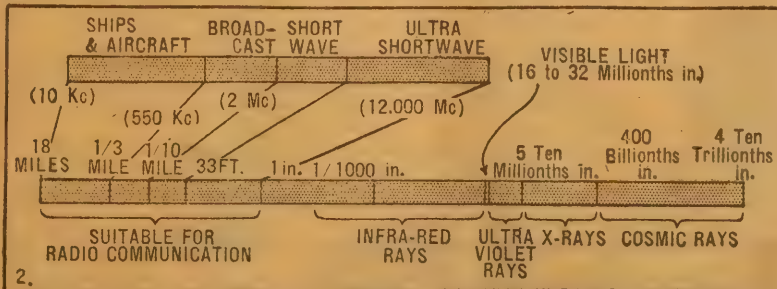


Fig 2: Showing the relationship between the various electromagnetic radiations. The scale is plotted on logarithmic paper in order to fit in the tremendous range between the shortest wavelength of the cosmic rays and the longest radio waves.

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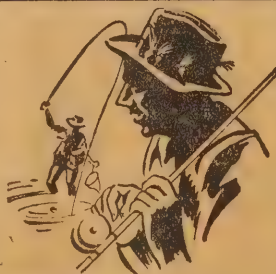
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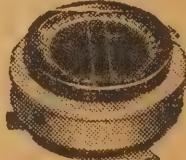
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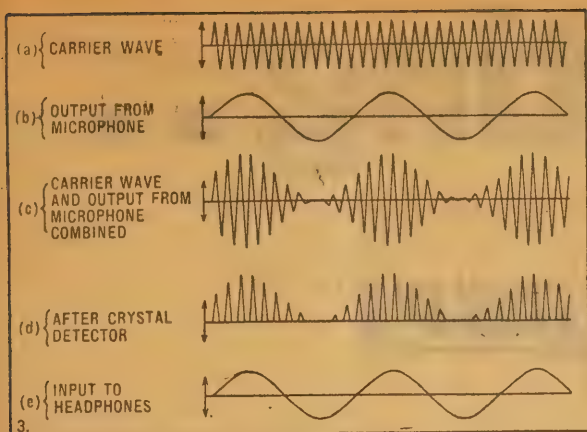


Fig 4: An excellent experiment to illustrate the phenomenon of resonance may be carried out with very simple apparatus. For best results, make corresponding pendulums exactly the same length and attach similar weights.

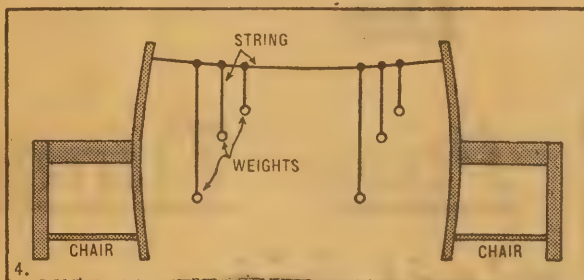


Fig 3: This diagram shows how the carrier wave and impulses from the microphone are combined at the transmitter and, finally, how a reproduction of the original microphone impulses appear at the headphones. The graph representing the signal radiated by the transmitting aerial and picked up by the receiving aerial is shown at (c).

reverses its direction of flow becoming stronger until it is just as strong in the reverse direction. After that it again falls to zero and the whole cycle of events is repeated.

Now fancy trying to "listen" to this on an earphone. It all happens so quickly that before the diaphragm of the headphone has had time to move in sympathy with the first impulse, the current has reversed its direction and tries to make the diaphragm move in the opposite direction. The result is that it does not move at all. This is the reason that you do not hear any sound when you connect the headphones directly to the aerial.

However, the difficulty can be overcome by connecting into circuit a device which allows the current to flow in one direction only. This can be either a crystal detector or a valve, but we will have more to say about it later.

The result is that the current impulse reaches a peak value in one direction and then falls to zero but when it tries to reverse its direction it is prevented from doing so by the crystal detector. The diaphragm of the headphone is therefore not called upon to try to move in different directions within a small space of time. Instead, all the current impulses are in the same direction and the diaphragm is able to follow their

strument produces waves of compression and rarefaction in the air.

These sound waves are picked up by a sensitive device called a microphone which turns the sound waves into electrical impulses corresponding with the original sound.

These electrical impulses are applied to the device which produces the carrier wave in such a way as to make the strength of the carrier wave vary in sympathy with the original sound. The carrier wave then contains all the intelligence of the original sound but in addition is able to travel over great distances which, of course, the sound cannot do on its own.

WHAT ACTUALLY HAPPENS

The impulses that appear at the receiving aerial are at the rate of the carrier wave which may be, say, 1,000,000 cycles per second and the strength is varying at a lower rate which may be anything between about 100 and 20,000 cycles per second. The diagram of Fig. 3 will give you some idea of what happens.

Just to make the matter clearer we will imagine that there is a simple note at 1000 cycles being transmitted. While every cycle of the tone is being transmitted there will be 1000 of the carrier impulses transmitted. While every one of these impulses may have a different strength, they are separated from the previous and following impulse by the same amount of time.

Diagram (c) of Fig. 3 is a representation of the carrier wave with sound impulses impressed on it as it appears on your aerial. As in the other cases, the horizontal axis of the figure represents time and the vertical axis represents the strength of the current.

We start to consider what happens over on the left side of the graph. First of all the current starts from nothing and then rises to a certain value in one particular direction after which it again falls back to nothing. But, instead of staying at zero or increasing again, the current



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average value. A conventional representation of what happens is given by Fig. 3d.

As we have already said, this average value is controlled at the transmitter by the impulses from the microphone. Therefore the diaphragm of the headphone follows the impulses from the diaphragm of the microphone at the transmitting studio and so you are able to hear sounds which take place a long distance away. All this depends on the property of the electromagnetic waves to travel over great distances.

Numerous signals

However, there is one difficulty that we have not yet mentioned. The receiving aerial is intercepting not only signals from one radio station, but hundreds and perhaps thousands of stations. Of course, many of these will be so weak that the currents induced in the aerial will not have any audible effect on the headphones. However, if you live in the city you will find that there will be anything up to half a dozen stations which will induce currents in the aerial sufficiently strong to be audible in the headphones. Therefore, not only is it necessary to have a crystal detector or a valve to make the currents flow in one direction, but it is also necessary to have a device which is able to select the station you wish to hear from the remainder.

After all you would need to have marvellous powers of concentration if you were to pick out the desired program if five or six programs are to be heard in the headphones at one and the same time!

Fortunately, it is possible to use an electrical device called a tuned circuit to pick out the desired station from the other stations which do not interest you. It is hard to explain the operation of a tuned circuit in electrical terms so we will introduce a couple of mechanical analogies to give you the general idea.

Natural frequency

Practically everyone is familiar with a tuning fork of the type used to check the pitch of a musical note. It has a pair of steel rods which vibrate when tapped against a bench. The rate, or frequency, at which it vibrates depends on the length of the rods and their weight. A large tuning fork could be expected to sound a low note while a small tuning fork could be expected to sound a high note.

By adjusting the components of the transmitter it is possible to make it vibrate, or oscillate, to use a word more suited to radio, at the particular frequency desired. Obviously the frequencies of the various stations must be chosen very carefully if interference between stations is to be avoided.

It is possible to do a very interesting mechanical experiment to illustrate how the rate of vibration can be changed and how other objects which have a similar rate of vibration may be made to vibrate easily at the particular frequency.

Stretch a piece of string between two chairs and near one end suspend three small pieces of metal or pieces of wood by means of pieces of string, each piece of string being of a different length. Give each one a push and notice how it oscillates backwards and forwards.

(Continued on Page 96)

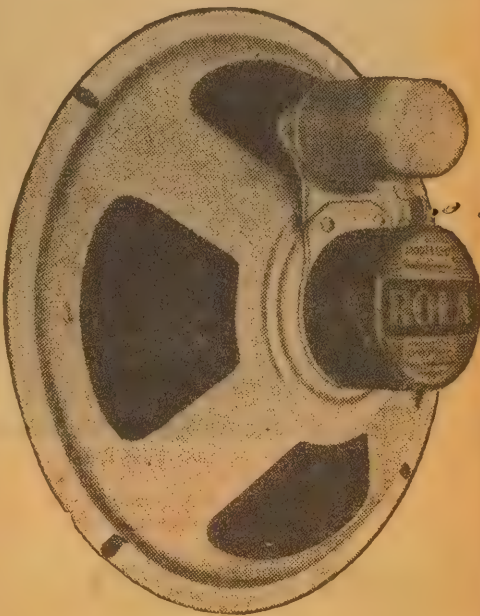
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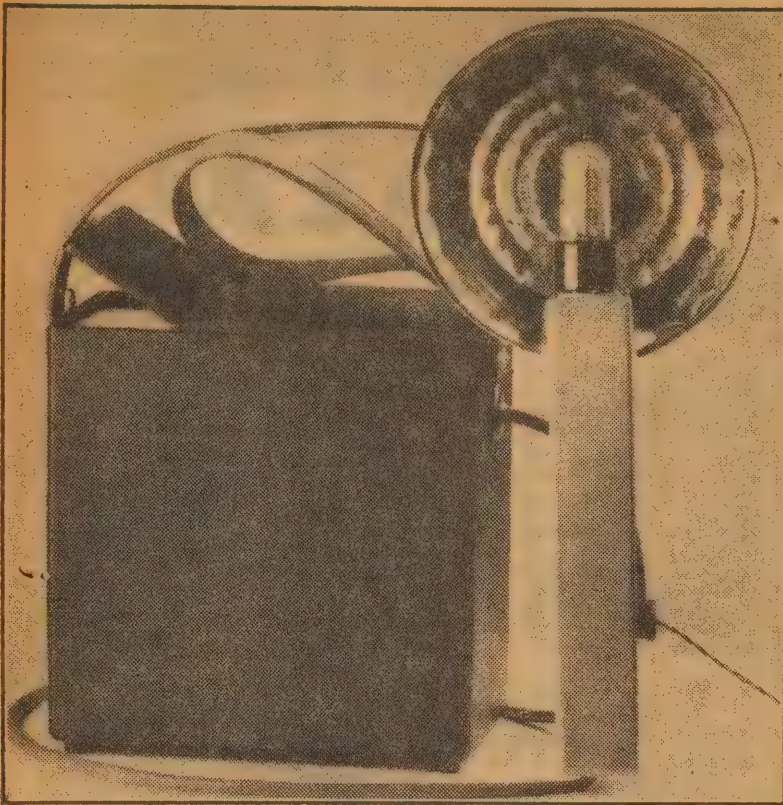
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The complete unit with gun and reflector. The lid on the right hand portion is screwed down and serves the battery supply. The battery compartment is under the hinged lid on the left. Note the main outlet plug on the right hand side of the case and the small trigger circuit plug on the right side of the gun.

the tube itself, since this will govern, at least in part, the design of the remainder of the equipment.

The tube used in this equipment was the Mullard LSD3 which is a type specially designed for portable equipment. It has a maximum rating of 100 joules and is designed to operate at voltages between 2000 and 2700, released from a charged capacitor.

The triggering voltage was originally quoted at 3000 but in the latest version this has been raised to 4000, a feature which the makers found desirable to prevent premature flashing of odd tubes when operated at the maximum voltage of 2700.

VALUES NECESSARY

To obtain the maximum light output of which the tube is capable a capacitor of 27 mfd is required when the tube is operated at the full voltage rating of 2700, 33 mfd is required at 2500 volts, and a 50 mfd at 2000 volts. Although individual tubes will flash at less than 2000 volts, the makers will not guarantee consistent operation below this figure and do not recommend it as a means of reducing light output.

In size, these tubes are similar to a standard GT valve and are fitted with a normal four pin base. Pins one and two are joined together to form the anode connection, pin three is the trigger, and pin four the cathode.

The color of the light emitted is claimed by the makers to be very close to daylight and quite suitable for use with color films without the need for compensating filters. The life is rated at 10,000 flashes but this appears to be a rather conservative figure since there have

DESIGNING A PHOTOFASH UNIT

As we hinted last month, we have recently spent a lot of time investigating the practical angle of electronic flash construction, with particular regard for the problems of the amateur. This article details the results of our experiments, presented in a way which will enable you to make your own choice about the final design.

WE have called this article "Designing a Photoflash Unit" because it differs somewhat from the ordinary run of constructional articles.

Due to the widely differing requirements of individual photographers it is almost impossible to design a single unit which will suit them all. While there is most interest in the portable type of unit there are quite wide variations even within this field and the final design is usually a compromise between several conflicting factors.

For this reason we decided to build a unit which would serve as a basic design, describe its construction and performance, and then detail those modifications which are possible to achieve variations of this performance. Thus we will detail a basic circuit with typical values and modifications and also describe the components which are normally

available for this class of work.

From this point you can evolve your own design (if ours is not exactly what you require) and be reasonably sure that the final result will be what you want.

Since many of the components used in electronic flash equipment will be new to readers, it might be helpful to first introduce these and detail their characteristics. Probably the first one to be considered is

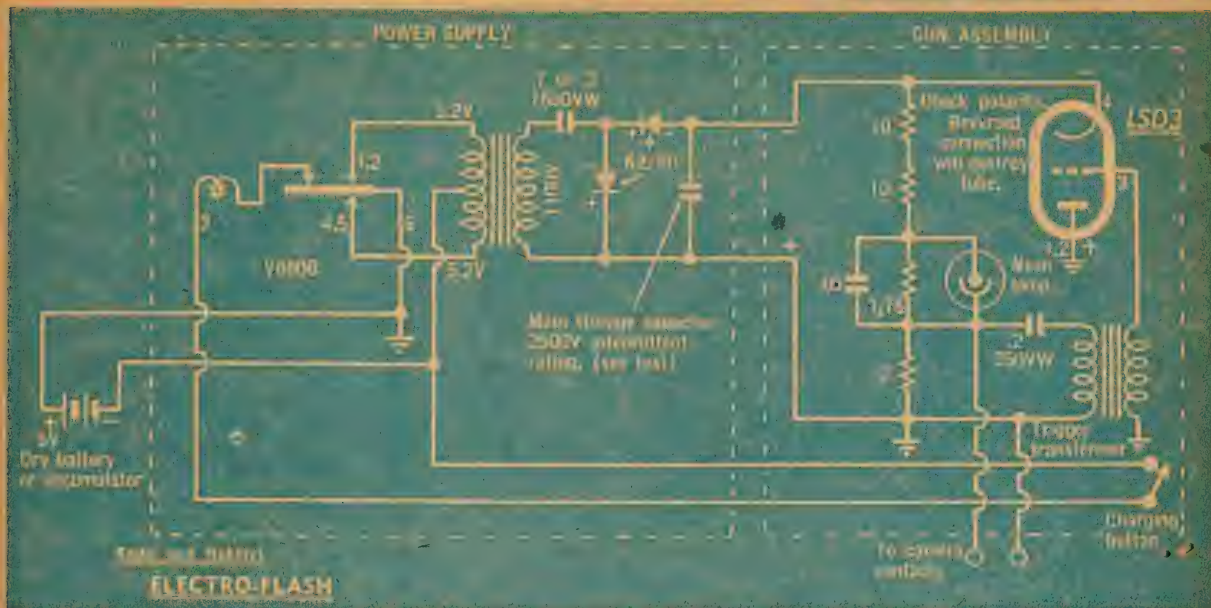
recently been reports from commercial users of tubes still operating satisfactorily after over 100,000 flashes. The color of the light appears to remain essentially constant over the useful life of the tube.

However, it is important to see that these tubes are not over rated or their life is likely to be seriously reduced. It must be realised that, because of the extremely short duration of the flash, the total life of the tube is only a few seconds. The makers also warn that the tube will be completely ruined after only two or three flashes if it is connected with reversed polarity and this point should be very carefully checked before it is put into operation.

Next item is the capacitor. Main difference between the units used for this kind of work and the ordinary radio type is that they operate at much higher voltages and have a lot more capacitance. As a result

by Philip
Watson

CIRCUIT OF THE POWER UNIT AND FLASH GUN



The circuit shows the basic principles of the flash equipment and also how the parts are distributed between the power supply and the gun. The 1.75 meg. resistor will probably need to be adjusted to suit individual lamps and the required capacitor change. The value of the main storage capacitor may be selected to suit the light output required.

they are very much bigger, heavier, and more expensive than those which you are used to handling and, in fact, this item will probably be the heaviest and most expensive in the whole equipment.

By far the most important point to realise about these units is that they store a considerable amount of electrical energy at a high voltage and, as a result, are quite capable of delivering a fatal shock. This point cannot be emphasised too strongly, particularly as the equipment does not operate from the mains and may appear to be quite harmless.

In addition, the charge stored in the capacitor may be retained for days, or even weeks, if some form of bleed is not provided to discharge it so that, even after it is disconnected from the equipment, it may still be dangerous.

SAFE IN USE

The above should not be taken as inferring that the equipment is too dangerous for ordinary use, any more than a radio or other appliance is regarded as dangerous because it operates with high voltages in certain parts of the circuit. It simply means that the builder and user must accept the idea that such voltages exist in this equipment, too, even though it is not connected to the mains and operates from only a few low voltage batteries.

Most makers supply these capacitors with the connecting leads shorted together to prevent any possibility of accidents, and it is a good idea to follow this practice yourself when the unit is not actually connected into the circuit.

On no account be tempted to indulge in practical jokes with these units, even when charged to only one or two hundred volts, for they still store a dangerous amount of energy.

There are a number of sizes and

makes of photoflash capacitors available on the Australian market, from both local and overseas manufacturers, and most of these have been given a voltage rating on the basis of the intermittent nature of the job they are to do, and this rating does not apply for continuous operation.

What appear to be two of the most attractive units are made by the English TCC Company and are known as the HK28 and the HK33. The HK33 is rated at 33 mfd and 2500 volts DC. It weighs 6½lb, measures 5¼in x 4¼in x 4¼in and, when operated at its full ratings, is capable of driving the LSD3 tube to its full output.

The HK28 is rated at 28 mfd at 2500 volts and weighs 4½lb with proportionately smaller dimensions. When operated at its full ratings it will deliver 87 joules to an LSD3 tube. This is not a serious reduction in light output and this size appears to be a very good compromise between performance on the one hand and weight and cost on the other. Local stocks appear also to be better than the HK33 at the moment.

Most Australian units appear to be larger and heavier for an equal capacity and, if these have to be used, there will need to be some

reduction in performance for the same weight or, alternately, a greater weight for the same performance. At the moment fair stocks of the English units are available but it is difficult to say when there will be further shipments, due to the import restrictions.

SMALLER VALUE

One Australian firm is planning an 18 mfd, 2500 volt unit which will be similar in size and weight to the HK28 and, although the light output will naturally be considerably less, there will still be sufficient for many applications.

The following power ratings may assist your choice in this matter. The 33 mfd at 2500 volts delivers 100 joules, and at 2000 volts 66 joules. The 28 mfd gives 87 joules at 2500 volts and 56 joules at 2000 volts. 18 mfd will give 56 joules at 2500 volts and 36 joules at 2000 volts.

The rectifiers: These are the selenium dry type and have the advantage over valve rectifiers of not requiring any filament voltage, a very important point when operation from dry batteries is being considered.

Two types appear to be available, the Sentercel type K2/50 and the Sentercel type N2/50 both of which

DANGER

THE CAPACITOR IN THIS UNIT CARRIES A LETHAL CHARGE IN EXCESS OF 2000 VOLTS AND MUST BE COMPLETELY DISCHARGED BEFORE HANDLING.

CHECK CABLES PERIODICALLY TO AVOID RISK OF SHOCK.

Paste this notice on the power supply where it will be seen as soon as the case is opened. It will serve as a reminder to yourself and a warning to others not familiar with such equipment.

STANDARD Mullard ELECTRONIC FLASH TUBES

Type	Energy	Flash Duration	Peak Light Output	Mean Light Output	Base	Operating Voltage (KV)	Trigger Voltage (KV)	Application
LSD 2	35 joules	1 micro sec.	Light of high actinic value		Stan. Edison Screw	5 to 10 KV	5 KV min.	Ultra high speed photography
LSD 3	100 joules	150 to 300 μ S	40 Megalumens	4,000 Lumen-secs	3 pin U.X.	2 to 2.7 KV	3 KV min.	Portable photo flash equipment
LSD 3A	100 joules	150 to 300 μ S	40 Megalumens	4,000 Lumen-secs	UK 3 pin 5 amp. base	2 to 2.7 KV	3 KV min.	Replacement for Siemens type SF3
LSD 4	400 joules	300 to 600 μ S	66 Megalumens	26,000 Lumen-secs	Special 3 pin	2 to 2.7 KV	3 KV min.	Studio equipment (provision for modelling lamp)
LSD 5	1,000 joules	1 to 2 mS	100 Megalumens	70,000 Lumen-secs	Special 3 pin	2 to 2.7 KV	3 KV min.	" " " "
LSD 6	10 joules	Compact light source of 1 c.c.			Wired in	2 to 2.7 KV	3 KV min.	Water cooled point source of light. Photo medical applications.
LSD 7	200 joules	250 to 400 μ S	60 Megalumens	10,000 Lumen-secs	4 pin U.X.	2 to 2.7 KV	3 KV min.	Portable or small studio equip.
LSD 8	30 watts max.	Max. repetition frequency = 30,000 r.p.m.			4 pin U.X.	2.7 KV max.	3.5 KV	For stroboscopic apparatus
LSD 9	1,000 joules	Considerable output in U.V. region			4 pin U.X.	2 to 2.7 KV	3 KV min.	Industrial and Research (silica spiral envelope)
LSD 10	10,000 joules	5 to 7 mS	600 Megalumens	500,000 Lumen-secs	Wired in	2 to 4 KV	3 KV min.	Film set, theatre, airfield, beacons, aerial photography
LSD 11	200 joules	Length 14"; flashpath 12"; diameter 4 mm. glass			Direct Connection	2 to 2.7 KV	Trigger Voltage 3 KV approx. (dependent on external trigger electrode design)	Specialised & scientific applic'n.
LSD 12	100 joules	Length 11"; flashpath 9"; diameter 4 mm. glass			Direct Connection	2 to 2.7 KV		Specialised & scientific applic'n.
LSD 13	600 joules	Length 20"; flashpath 18"; diameter 4 mm. glass			Direct Connection	2 to 2.7 KV		Specialised & scientific applic'n.
LSD 14	2,500 joules	Length 28"; flashpath 24"; diameter 6 mm. glass			Direct Connection	2 to 2.7 KV		Specialised & scientific applic'n.
LSD 15	200 joules	Length 16"; flashpath 14"; diameter 4 mm. glass			Direct Connection	2 to 2.7 KV		Specialised & scientific applic'n.
LSD 16	500 joules	Length 11"; flashpath 9"; diameter 4 mm. quartz			Direct Connection	2 to 2.7 KV		Specialised & scientific applic'n.
LSD 17	1,000 joules	Length 14"; flashpath 12"; diameter 4 mm. quartz			Direct Connection	2 to 2.7 KV		Specialised & scientific applic'n.
LSD 18	2,500 joules	Length 20"; flashpath 18"; diameter 4 mm. quartz			Direct Connection	2 to 2.7 KV		Specialised & scientific applic'n.
LSD 19	100 joules	150 to 300 μ S	40 Megalumens	4,000 Lumen-secs	4 pin U.X.	2 to 2.7 KV	3 KV min.	Replacement for Anglo 5804X

Special tubes also made to customer's specifications.

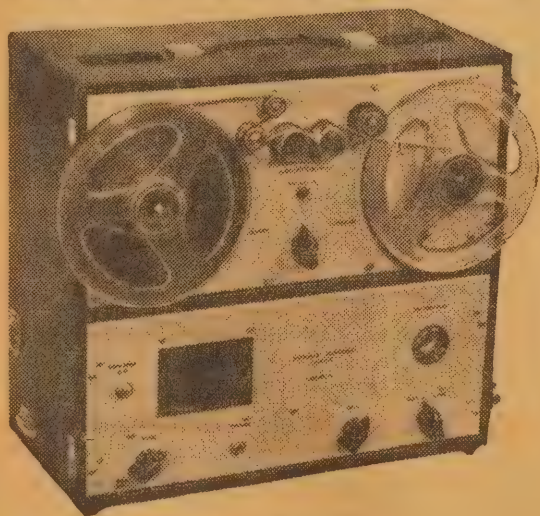


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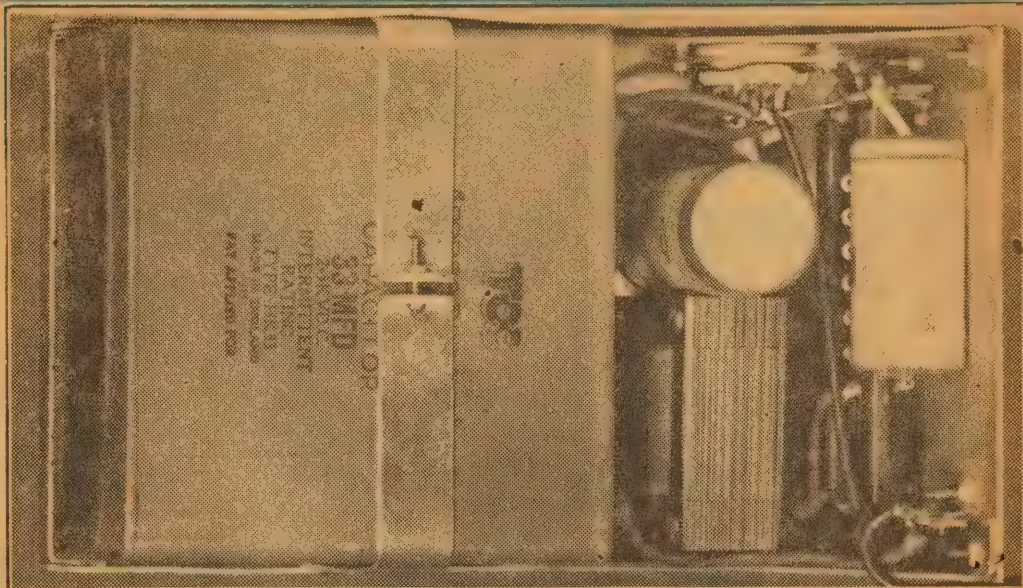
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POSITION OF MAJOR COMPONENTS IN POWER UNIT



A picture of the complete power supply. The main stage capacitor is on the left, the vibrator transformer to the right of it and above this the vibrator and the ceramic output socket. The capacitor on the right is the voltage doubler beneath which are the two rectifiers.



have the same electrical characteristics but different terminals, the K2/50 using pigtailed, while the N2/50 uses screw terminals. Small stocks of the K2/50 are available at the time of writing while it is expected that ample stocks of the N2/50 type will be available by the time this article appears in print.

The transformer: This is a fairly straight forward design and no difficulty should be experienced in obtaining it from local manufacturers. The nominal primary voltage is 5.2, a figure which was arrived at after observing the performance of typical dry batteries under the load conditions imposed by this kind of service. The secondary voltage is 1100 which, after being doubled and allowing for some peaks in the wave form, will produce a voltage of just under 2500.

The trigger transformer: This is a small unit, designed to be accommodated in the gun, and should be available from the same manufacturer who supplies the main transformer. It is designed to produce a pulse of approximately 4000 volts when the primary is connected to a .2 mfd capacitor charged to approximately 250 volts. This pulse is applied to the trigger electrode to ionise the tube.

BATTERY PROBLEMS

The battery: This presents one of the major problems with this type of equipment and the final choice will depend on several factors, both dry batteries and accumulators having points for and against.

The dry batteries have the advantage of lower first cost, particularly as no charger is required, and are also clean and lighter in weight. However they have the disadvantage of a high internal resistance and have difficulty in supplying the heavy current required at the beginning of the charge.

From our experiments we found that four cycle lamp batteries, connected in series parallel to provide 6 volts, or two lantern batteries in parallel, were about the best compromise between weight and power,

together with a reasonable charging time.

Even so, the use of dry batteries would appear to be limited to instruments of 50 joules or less and, where higher powers are required, the accumulator is to be preferred.

At least one manufacturer has realised the limitations of ordinary dry batteries and has marketed a special battery, similar to the cycle lamp battery, but designed for the heavier discharge rates encountered in this work. It is normally sold by photographic dealers and is slightly dearer than the standard type.

PARTS LIST

- 1 Mullard LSD3 flash tube.
- 1 Chassis. (See text).
- 1 Main storage capacitor (See text).
- 1 or 2 .1 mfd 1500VW tubular capacitor (See text).
- 2 .1 mfd .350VW midget tubular capacitor.
- 1 .05 mfd 350 or 500VW midget tubular capacitor.
- 2 10 meg. 1 watt resistors.
- 1 2 meg. ½ watt resistor.
- 1 1½ meg. ½ watt resistor. (Approximate. Adjust to suit neon. See text).
- 1 vibrator transformer. 5.2V primary. 1100V secondary.
- 1 triggering transformer. 250V primary. 500V secondary.
- 2 K2/50 or N2/50 selenium rectifiers.
- 1 Neon lamp.
- 1 miniature speaker socket and plug.
- 1 6-pin bakelite socket.
- 2 4-pin ceramic sockets.
- 1 4-pin bakelite plug, screw cover type.
- 1 press button.
- 1 dual interrupter vibrator.
- 2 lantern batteries or 4 cycle lamp batteries.
- 6 7 terminal tag strips.
- 1 8 terminal tag strips.
- 1 5 terminal tag strips.
- 7 mm plastic tubing, plastic flex, hook up wire.
- Countersunk screws, nuts, solder, lugs, &c.
- Carrying case, gun housing, and reflector to suit.

In any case, there is no reason why an ordinary accumulator should not be used when working in a studio, and the reduced input voltage of the transformer will allow fairly long leads to be used.

To facilitate this it is suggested that a miniature speaker socket could be mounted on the side of the chassis nearest the battery compartment and that the dry cells be normally connected to it by means of a matching plug. A similar plug may be fitted to a length of twin flex with battery clips at the other end.

ELECTRICALLY BETTER

The accumulator is capable of a much superior performance electrically but has the disadvantage of higher first cost, plus a charger, as well as rapid deterioration if it is not given correct maintenance. It is also somewhat heavier and rather messy compared with the dry cell.

Of those used commercially the most popular appears to be an imported "dry" accumulator, reasonably small and light, and which is usually used as a four volt battery. Transformers are available to suit, and an ordinary 6-volt vibrator appears to be quite reliable at this voltage.

The carrying case was made from 3/8in plywood and covered with black leatherette. The inside dimensions are 8 13/16in x 4 3/16in x 9 1/2in high. A partition divides the batteries from the main power unit and the two compartments measure 5 1/2in for the power unit and 2 11/16in for the batteries. A screw-on lid covers the power supply and a hinged lid the battery compartment.

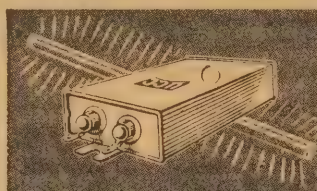
The remaining components are more or less standard and can be discussed with the circuit and constructional details. The circuit is similar to one issued by the Mullard Company but which we have modified slightly to suit our own requirements.

Its main features are the use of a voltage doubling circuit which greatly simplifies the design of the transformer, and the use of dry rectifiers

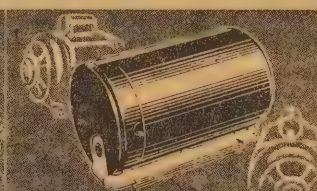
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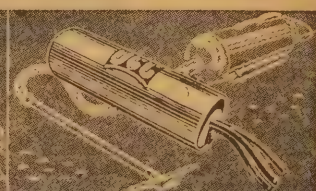
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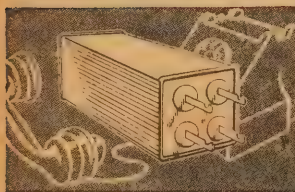
FLUORESCENT LIGHTING



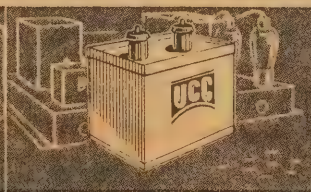
MOTOR STARTING



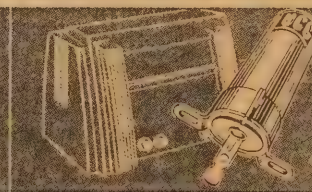
INTERFERENCE SUPPRESSION



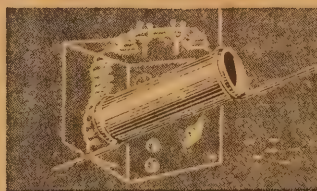
TELEPHONE EQUIPMENT



FILTER CIRCUITS



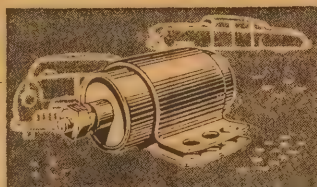
RADIO RECEIVERS



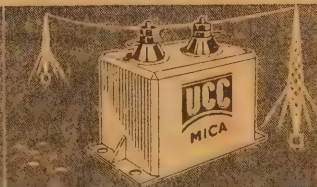
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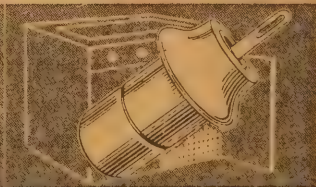
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to reduce the overall current consumption by eliminating valve filaments. This also simplifies the design of the unit somewhat since there is one less circuit to be controlled.

HOW IT WORKS

The voltage from the battery is applied to the two halves of the transformer primary alternatively, by means of the vibrator, and appears as a high voltage across the secondary. The two half-wave rectifiers then restore it to DC, at the same time doubling the voltage which is finally applied to the main storage capacitor.

The value of the voltage doubling capacitor will govern the time taken to charge the main capacitor, the larger the value the shorter the charging time, but the higher the initial current from the battery. For this reason there is not much point in using a value above .1 mfd when dry cells are used, but a value of .2 mfd is useful when working from an accumulator. The voltage rating needs to be 1500 volts working.

Across the main capacitor is a bleed resistor consisting of two 10 megohm resistors and two smaller ones all in series. The purpose of the smaller resistors is to provide voltage for two auxiliary pieces of equipment, namely, the neon indicator and the triggering circuit.

The triggering circuit consists of the .05 mfd capacitor and the primary of the triggering transformer connected in series across a portion of the bleed presenting about 250 volts.

As the main capacitor is charged so is the smaller one, the DC resistance of the transformer primary being negligible. When it is fully charged and the switch is closed the sudden surge through the primary produces the necessary peak of voltage across the secondary winding.

INDICATES CHARGE

The purpose of the neon indicator is to indicate when the capacitor is fully charged and it is connected across a value of resistance in the bleed which will cause it to strike when the voltage across the main capacitor has reached a working value. As a further indication of the state of the charge a small capacitor is connected directly across the neon tube which causes it to act as a relaxation oscillator and the frequency of the neon flicker gives an indication of the voltage across it.

The voltage at which the neon tube will ionise varies from one lamp to another and it will be necessary to adjust the section of the bleed network across which it is connected until it flashes when the required voltage is developed across the main capacitor. The exact point in the charging cycle at which the indication commences can be left to the individual to decide, since it provides a means of controlling the light output, but it should not be less than 2000 volts.

A logical suggestion at this point is that the lamp could be switched to different points on the network enabling the capacitor to be charged to different voltages. Thus a setting at 2000 volts would provide a minimum charging time and battery consumption with enough light for most requirements, while a 2500-volt setting would enable the maximum light to be obtained when conditions warranted it. (It must be realised

GUN DETAILS



the power change is equal to the square of the voltage change.)

Control of the vibrator is provided in a very simple manner, namely, by placing a switch in the lead to the energising coil. This provides a control circuit which operates at a low voltage and low current and it is only necessary to extend a pair of light leads to the gun where the circuit is controlled by means of a push button or other suitable switch.

EARTHED POSITIVE

From the circuit it will be seen that the positive side of the circuit is at chassis potential while the negative lead is "hot." This is in accordance with the tube maker's specifications which recommend that the trigger and anode (plate) both be at chassis potential before the tube fires in order to prevent premature flash.

Physically, the whole equipment is divided into two units, the power supply, and the control unit or gun. The power supply consists of the batteries, vibrator, transformer, rectifiers, voltage doubling capacitor, and the main storage capacitor. The gun consists of the triggering transformer, the bleed resistor network, the neon indicator, a press button to control the vibrator, the flash tube itself, and sundry minor components associated with this part of the circuit.

The general arrangement of the components in both units can be seen in the photographs but a brief description may help. The chassis measures 5 1/2 in x 4 1/2 in x 8 1/2 in high. When it is in the normal operating position the vibrator is horizontal, a mode of operation which is quite permissible providing the reed is in a vertical plain. This is achieved when the earthing lug from the mechanism to the can is either at the top or the bottom when the can is horizontal.

EXTRA SUPPORT

It is also advisable to provide some support for the vibrator, other than the socket, when it is mounted in this position and, by mounting it alongside the transformer, a small aluminium strap may be used to hold it against the core, the transformer bolt serving as an anchor point.

The size of the chassis was chosen with a view to accommodating most of the capacitors available on the Australian market and it would no doubt be possible to modify the dimensions when a particular size had been decided upon, though it is doubtful whether many inches could be saved. This is a matter best left to the discretion of the builder himself.

The rectifiers and voltage doubling capacitor are mounted against the top of the chassis on terminal strips. Because of the high voltage involved in this part of the circuit it is advisable to allow plenty of space between high voltage points on these strips and the chassis mounting lugs, and at least one unused lug should be left as a spacer.

When making soldered connections in any part of the high voltage circuit soldering pastes should not in

This picture of the complete gun assembly is almost full size. The coding will help you to identify the parts which are mostly midget types. Note the strain clamp at the bottom to protect the cable from strains and twists.

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any circumstances be used, otherwise flashovers are almost inevitable. This is not a serious restriction and it should be possible to do the whole job with resin-cored solder alone. To prove this we made a point of using nothing else for any of the soldered joints and had no trouble

DUAL INTERRUPTER

The vibrator should be a dual interrupter type, such as the Oak V6606. We used a synchronous type with the two sets of contacts wired in parallel for our early experiments and this appeared to be quite satisfactory. The socket required is a standard 6-pin and this is mounted on insulated supports to raise it above the chassis.

A four pin socket is used as an outlet socket, and this is mounted on a side of the chassis which will be against the front of the carrying case when finally mounted. Two of the pins carry the control circuit for the vibrator coil and the other two carry the high voltage supply from the main capacitor. To minimise the possibility of breakdown we chose a ceramic type such as is generally used for medium-power transmitters.

Ideally we would have liked a ceramic plug to go with it, but these are not readily available, so we had to settle for a good quality moulded bakelite type with a screw cover. It appears to be able to withstand the applied voltage without difficulty. The most important points seem to be to avoid the type with a press-on metal cover (for obvious reasons) and to avoid the use of soldering paste.

The cable from this point to the gun is made up of four wires encased in plastic tubing of about 7mm diameter. For the control circuit, light duty hook-up wire is quite satisfactory, but the high voltage cables require both heavier wire and insulation.

MAKING THE CABLE

After some investigation we decided to use ordinary "figure of eight" twin plastic lighting flex, which appears to be quite capable of withstanding voltages of this order, being tested during manufacture at a voltage of 6000 AC RMS. This insulation, plus the plastic outer tubing, should provide a wide margin of safety for the operator.

To prevent any strain being placed on the soldered connections in the plug, the outer plastic tubing was bound with strong cord before the plug cover was fitted, and the binding so placed that the cover would press against it when the latter was screwed into place. Similarly a strain clamp was provided inside the gun both to prevent strain on the soldered joints and to prevent the cord from rotating inside the gun which would have the same effect.

The gun is made from aluminium and is similar in style to commercial units except that it is rectangular rather than cylindrical.

Actually the latter style is something of a carry-over from flash bulb equipment and there is no reason why the components should not be housed in almost any shape case. Once again the individual can make his own decision in this matter.

Our unit measures 10in. long by 15/8in square (inside dimensions) and was bent up from one piece of metal to form three sides and the two ends, the fourth side being provided in the form of a cover which

is held in place with self tapping screws.

For the tube socket we once again chose a ceramic socket, this one having to withstand the 400 volts triggering impulse as well as the main capacitor voltage. It is mounted in one end of the gun so that the tube protrudes where it may be placed in the focus of a suitable reflector.

The triggering transformer is placed immediately below it and in our case was mounted by means of a small aluminium bracket, there being no mounting holes in the laminations. It is recommended that the lead from this transformer to the tube socket be kept reasonably short, otherwise capacitance to the frame may destroy the peaky nature of the pulse which is essential for reliable firing.

Beneath this is mounted the neon lamp. A miniature type is really required here and we understand that these are normally available. However, a temporary shortage forced us to use a standard pilot socket type, mounted vertically. This provides a perfectly satisfactory indicator if the outer electrode is placed level with a viewing hole in the body of the gun and the connections arranged so that this electrode glows when the lamp strikes.

No socket is used, the lamp being

soldered to two terminals on a small tag strip.

PRESS BUTTON

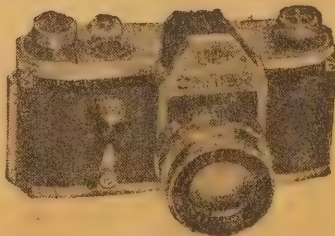
Next comes the press button in the vibrator circuit and for this we chose an Alpha type "S" press on, which is a single hole mounting type requiring a minimum of space. Other types, such as bell pushes, could be used, but it is desirable to select one which is easy to use, since there are many other jobs to be attended to while the unit is charging.

Just below this, and on one side of the gun, is a miniature speaker socket which provides connection between the camera contacts and the triggering circuit. On the opposite side are two tag strips, one above the other, carrying the 10 megohm resistors of the bleed network. The triggering socket may be mounted on either side, depending on how the gun is to be mounted on the camera, and this, again, is something which is best left to the individual builder.

Capacitors for use in the gun should be of the midget type, usually rated at 350 volts, the standard sizes being rather bulky though it may be possible to squeeze them in, with some rearranging of the layout.

(Continued on Page 91)

NEW CAMERAS FOR OLD!



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Leica IIIc Summitar ..	£80/-
Rolleiflex Automat	£70/-
Futura f2.8 Xenar	£35/-

These prices are approximate and assume that the cameras are in new condition.

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TRADE REVIEWS AND RELEASES

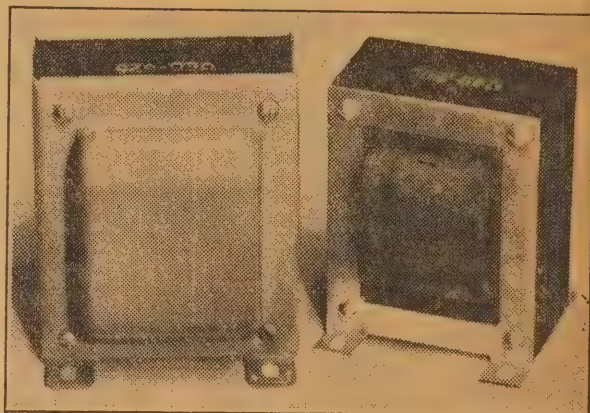
"NATIONAL" TRANSFORMERS RELEASED TO TRADE

"National" power transformers, widely used in past years by the major set manufacturers, are now being distributed to the trade generally through Messrs. Wm. J. McLellan & Co. Pty. Ltd. Two typical transformers are illustrated at the right.

ONE transformer, as shown, is of open structure, using cadmium-plated clamps to prevent lamination hum. This finish is more or less standard for transformers rated up to a rating of 50 milliamperes. Both core and winding is impregnated with special varnish and oven-baked.

Transformers larger than the 50-milliamp type are normally supplied with metal shell covers, adequately louvered and finished in grey stoving enamel. The laminations are neatly stacked and leads are anchored inside the shell to prevent them being strained from their windings.

Receiver type transformers currently listed range from a 285-volt, 40mA. unit to 385-volt, 100 mA. All transformers have a 5-volt rectifier winding, with either one or two 6.3-volt windings, according to their size. "U" types are arranged for upright mounting and "F" types for flat mounting.



COIL KIT FOR WIDE-BAND TUNER

LATEST release from Kingsley is a special coil kit for a wide-band superhet tuner. It will be available shortly through Kingsley distributors in all States.

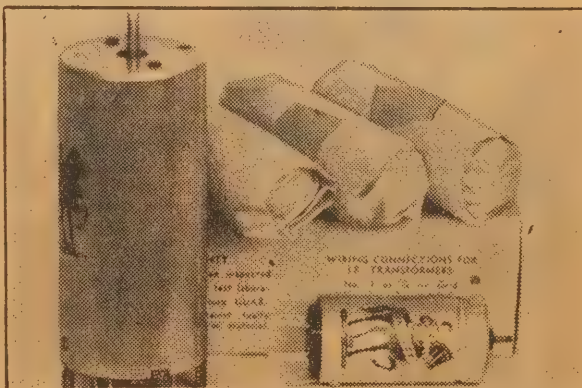
The kit comprises of a band-pass aerial tuner, special oscillator coil, two 1900 Kc. IF transformers, a whistle filter coil, and a selected padder condenser.

The band-pass system comprises two separate coils in small cans, intended for capacitance coupling, and giving a double-humped tuning characteristic. The oscillator coil is designed to track with the aerial filter to give a 1900 Kc. intermediate frequency, while the padder is a selected low tolerance mica unit. A standard converter valve such as the 6AN7 is assumed.

For the IF channel, the transformers are in standard large cans, the coupling being adjusted for maximum bandwidth consistent with good rejection of adjacent channels.

Final item in the kit is a 100 mH. coil in a small can, intended for the whistle filter circuit. This is the same type of circuit as specified recently in the R. & H. wide band tuners.

The manufacturers claim that the kit allows a response which is substantially level to 6 Kc., tapering thereafter to a sharp dip at 10 Kc. The alignment procedure is not specially difficult.



A further specialised line of step-down transformers operates from 240 VAC to 110 VAC with ratings ranging from 60 to 750 watts. A similar line is available for 32-volt circuits. These transformers are provided with input and outlet sockets for ready connection to the supply points.

Trade inquiries should be addressed to Wm. J. McLellan and Co. Pty. Ltd., 126 Sussex St., Sydney.

BRAMCO PRICE LIST

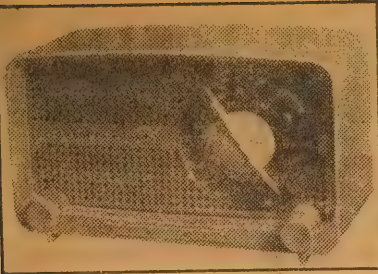
MESSRS. Phillips Agencies, sales representatives for "Bramco" products, have released a confidential trade price list which is available on application to all trade houses. The catalogue lists the full range of radio coils, replacement windings, plus sundry electrical replacement items, a line filter and a soldering pencil.

Address in Sydney is Phillips Agencies, 27 Hunter St. Telephone BW6436.

RCS AERIAL FILTER CUTS INTERFERENCE

A NEW kit, released recently by RCS, is intended to combat noise problems on the broadcast band. It involves erecting an efficient aerial and earth remote from the noise source, then using the two special transformers and a transmission line of plastic flex to convey signal to the receiver. The makers claim that a line up to 200 or 300 feet can be used, allowing most favorable placement of the aerial. The transformers are available through all RCS distributors.



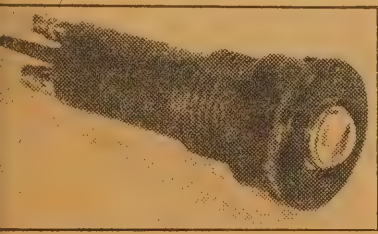


"GOLDEN VOICE" MANTEL SET

HOUSED in an attractive walnut, ivory or pastel green cabinet, the model 404-E mantel receiver is the latest product to be released from Messrs. A. G. Healing Ltd. Overall dimensions are 11 x 5 x 6½ in, with a 4½ in diameter dial, boldly marked with station call signs.

The receiver is a 4-valve reflexed superheterodyne, with tuning control, volume and combined off-on switch. The chassis, dial and 5 in speaker are mounted as a single unit to facilitate handling for service.

Model 404-E is available immediately through Healing distributors in all States. Retail price is £24/3/- for walnut, £24/13/6 for colors in the eastern States, a slightly higher charge obtaining in Western Australia.



PANEL INDICATOR

A NEW Australian-made neon indicator is now available for panel use where long life and low current consumption are required. Known as indicator type PL2, it is being distributed to the trade by Messrs. Wm. J. McLellan and Co. Pty. Ltd., of 126 Sussex St., Sydney.

Moulded in black bakelite, the flange is 1 in dia. x 1-8 in thick and is backed by a locking nut on a ½ in barrel carrying a standard conduit thread.

The lamp will normally operate on voltages from 240 to as low as 70 VAC but special units with a reduced internal dropping resistor can be supplied where bulk low-voltage orders can be placed.

Suggested applications for the lamp include industrial machines, domestic appliances and radio equipment, where low current consumption and absolute reliability are necessary.

DIALS
EFCO MK8. A cord driven kit dial with an overall diameter of 5½ inches. Complete with drum, drive spindle and cord.
At less than Half Price.
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Postage 1/- extra.

RESISTORS.
CARBON RESISTOR ASSORTMENT. Standard 1 watt types, all useful sizes —no odd values. Worth 25/-.
50 for 10/-
Postage 1/- extra.

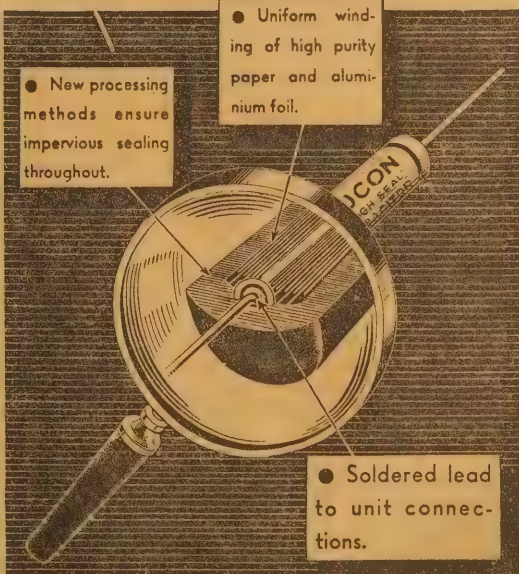
HEAVY DUTY CABLE
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modern radio receiver—and for
and discussion. Every now and
ent and is somewhat appalled
future, it seems inevitable that
it.

BY JOHN MOYLE

MOST of my readers will be familiar with the development of the modern microgroove, and the results it can give when played on the best type of amplifier. Many of them won't be able to think back to the days when we listened to the strangled noises or ear-splitting bellowings which came from the early acoustical machines, and thought them grand. They didn't have even a volume control, and the music rode out over a scratch level nothing short of murderous.

Our first electric pick-ups and dynamic speakers we thought were the last word. Even the best "re-entrant" acoustic machines sounded good on the best electric records of the day. I still remember the thrill I had hearing Sousa's Band play the Stars and Stripes march on a table model HMV which had just been released. I couldn't sleep for thinking about it.

GOOD TO BETTER

But we go on from good to better. I know now that the frequency range of that record as I heard it was pitifully small. I know from experience how long the grooves stood up to the pounding they got from the sound box. But with the Jazz Singer that record shares two of the most significant experiences in my mind as it concerns sound. Just as the former showed me the enormously expandable field in the new art of the talkies, so did Sousa's Band start me on the search

for record reproduction which would be good enough to be completely satisfying.

I don't say that I have heard this as yet. I got a pretty good glimpse of it when I played Decca's La Boutique Fantasque for the first time on my latest gear, a flashback to the same thrill I had 20 years ago with Sousa and Al Jolson. Inasmuch as it represented the first batch of good microgrooves, La Boutique Fantasque, with its wide frequency and dynamic range, its comparative freedom from distortion, its low surface noise and its long playing showed me what we might expect in possibly the final phase of the gramophone's development. If not the ultimate, then perhaps to the optimum beyond which many will not want to go.

So far so good. I know that there are plenty of people whose experience is much the same as mine, and who by taking some special interest and care have been able to keep their listening results fairly well in step with the times. But every now and then, something happens to make us realise the huge army of listeners who have no conception of what they are missing. They are literally living in the sound era we left behind 15 years ago by hearing records played on ancient or poorly designed gear, and whose standard of radio reproduction just can't be believed until the facts and figures are measured and placed on record.

RECORDS AND RADIO

When considering the entire field of listening, it's becoming more and more difficult to separate radio from records. As I commented in these columns some months ago, the long playing record will revolutionise radio just as it will and has done to the gramophone. The truth of this will be seen if we examine the number of hours devoted to playing records of all kinds. The future will show up quite vividly the difference between playing records at home and hearing them over the air with even greater force than it does at the present time.

At this point it might be in order to mention the increased power which the Broadcasting Board has promised the national stations—up to 50 kw. Sooner or later the same order of increase must come the way of the commercials. Most of them will probably invest in new transmitters for the occasion, and undoubtedly consider overhauling their studio facilities as well.

The chances are strongly in favor of better transmissions than we get today, and today they are patchy to

say the least. The foolishness of trying for extreme frequency range has so far been underlined by the necessity for severe restriction to avoid surface noise, etc., and because engineers know that the average radio set will reduce this range still further.

Recently we published some curves on the type of response to be expected from an old superhet, more modern types, and a TRF tuner of the type used for the Playmasters. These showed how much better was the high frequency end of the TRF, and they were strikingly borne out by results.

But we have gone further than this, and as promised at the time, have produced in collaboration with the coil manufacturers an entirely new tuner, the performance of which can only be described as revolutionary. The ideas it contains are not new, but the application is such that I don't think a better fidelity tuner has been produced in Australia, or for that matter anywhere else outside a laboratory.

It is now possible to connect your wide range amplifier to a wide-range speaker, and work both from a tuner which for the first time will give you the best and the worst from radio stations, to such an extent that the useful frequency range is more than doubled.

In figures, this means that a conventional radiogram might cover a useful range from about 65 cycles to 3.5 kc before serious attenuation takes place. Equipment such as I have mentioned will extend that range from about 50 cycles to 7 or 8 kc. That's rather a shattering thought, because it means that the best efforts of radio stations are now completely lost on the average listener.

FREQUENCY RESPONSE

The record position isn't very much better, although as we avoid the severe top cut of the tuner, we can expect to hear more. But realising that really good gear can extend the range up to about 15 kc, a reasonable average limit of hearing, even not-so-good-but-not-bad gear which might reach 7 or 8 kc is still a long way down the list.

In other words, all but a few listeners to both radio and records pay for a big slice of quality they can never hear.

At the moment, the radio trade is concerned at its inability to sell receivers in great quantities, although significantly radiograms are in ever popular demand. High sales tax and production costs have created an unavoidable sales resistance, but might not much of this be due to the



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SONGSTER
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PICK-UP & PHONO NEEDLES

fact that, apart from appearance and minor improvements, present sets don't offer worthwhile improvement in quality? They still send half the spectrum and more down the sink, even the best of them.

I am much reinforced in this view by a recent article occupying nearly 50 inches of space in the Wall Street Journal, a highly respected and authoritative American publication devoted to business trends.

"Merchants of Custom Radio-Phonographs Sets Report Sales Soaring," was its headline, followed by "Their Explanation — People Are Fed Up With Quality Of Most Ready Made Sets."

CUSTOM-BUILT GEAR

Without boring you with figures, the article went on to tell much the same story as I have told here, and with which we higher fidelity enthusiasts are familiar, and quoted turn-over figures supplied by large and small firms in the US which specialise in good quality gear. One firm did about 12,000 dollars of business in 1947, around 50,000 last year, and expects at least 200,000 this year! No wonder the Wall St. Journal thought the prospects merited special mention.

America is a good barometer for such things. Trends of this nature invariably find a repeat some time later elsewhere, particularly in Australia. I can't but believe we are heading in the same direction, and could go a long way in it by the use of courage and imaginative selling.

The power of salesmanship hasn't always rebounded in profitable directions in the radio world. Much of the cost of modern radio is due to a short wave section only a few people ever use. Buyers might now be hard to sell on the idea that high quality from local stations is much preferable to poor quality plus short waves which they don't use.

The use of high sensitivity for interstate listening these days is rather a farce. Even with high selectivity, which completely ruins quality, very few such programs are worth while.

NEW ERA WANTED

Isn't it a bit crazy? I think so. For that reason, we have always tried to give the man who wants decent sound from the locals plenty of encouragement by detailing suitable equipment in addition to standard stuff. This new tuner I think is quite the most important step we have taken to that end.

I am quite convinced that sooner or later someone will discover this new era in radio. It may not be cheap, but you and I know that we can still manage a one-sided grin, despite the cost, when we hear how good our new records and speakers really are. I do believe some designers are seriously considering this production of better sound and all the components required for it. I can't urge them strongly enough to get cracking, and start overhauling the heritage of poor radio and radio-grams we have suffered in the past.

Incidentally, before concluding, there is a point I'd like to mention which seems to be creeping into the minds of less technical people. It is illustrated by an advertisement I noticed in an English magazine claiming that Mr. X's equipment was to be preferred because the units

have all been "tuned" to work together.

This is the kind of statement which makes me see red. It has a modicum of truth, but it is distorted to give a completely false impression.

DOUBLE TALK

When we speak of tuning, we think of a violin or piano, which has lost pitch and therefore requires attention by a "tuner." This process is something integral with the production of music by the instrument itself.

Now an amplifier is not a musical instrument in this conception—it does not of itself create sound. It merely amplifies and reproduces sound which has already been created. If it were necessary to "tune" an amplifier, or combination of amplifier units, we could only conclude this to be a process of doctoring or shaping the output to give an effect which wasn't the same as the original, or to apply corrections to one unit to compensate for deficiencies in another. I think I am right in saying that every engineer tries to avoid this necessity at all costs, and if his equipment is good, hasn't much trouble in so doing. He tries to see that all the units concerned just don't require "tuning," because they exhibit "flat" charac-

(Continued on page 89)

GRAMOPHONE NEEDLES

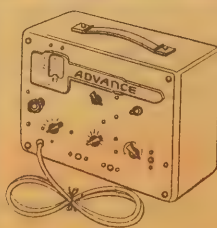
For the *Connoisseur* pick-up

Hard - chromium plated needles with green shanks, Radius of needle point guaranteed accurate to within the tolerance of .002"/.003". Each needle will play 30 sides, and up to 50 without damage to record.

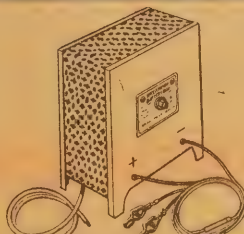
Connoisseur Sapphire Needles

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MELBOURNE C.I. CENT. 3688.

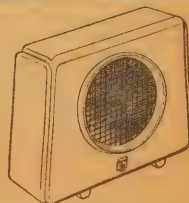
RADIO EQUIPMENT & COMPONENTS



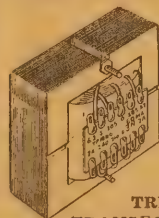
ADVANCE Signal Generator Model E2, 100 Kc/s to 100 Mc/s. AC operation only. £40/11/-. Plus Sales Tax.



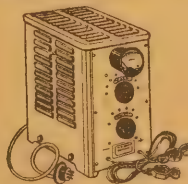
WESTINGHOUSE Battery Chargers, Model MR480, available either in 6 volt or 12 volt models. From £8/15/6.



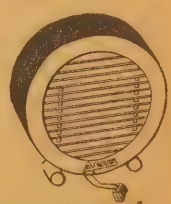
AEGIS de Luxe Polystyrene Extension Cabinet, complete with 8" speaker and Volume Control. Can also be used with SB1 control. £7/8/-.



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AEGIS Standard Extension Speaker for use in conjunction with SB1 control unit. £5/12/-

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THE HAM BANDS WITH BILL MOORE

AMATEURS DO GOOD WORK IN LACHLAN FLOODS

During June many NSW inland towns suffered from serious flooding when rivers rising on the Great Dividing Range reached record flood levels. Amateur radio stations especially in the Lachlan Valley were alerted, and able to assist various authorities by handling messages.

FORBES on the Lachlan, has suffered from repeated flooding in recent years, and during June, the town and valley area was devastated on two occasions, the second flood being the worst experienced on record.

During the first crisis which occurred between June 3 and 10, watches were kept by amateur stations on the Army frequency of 3882 Kc and the emergency frequency of 7002 Kc. Army "ducks" were engaged on relief work in the area. Some traffic was handled after Hugh Stitt, VK2WH, of Forbes, had obtained permission to operate on the Army frequency from official PMG station VK2AA. He and other stations continued to operate on this frequency for the duration of the flood.

John Meagher, VK2AMV, equipped his brother's Auster aircraft with 144 Mc equipment. The aircraft was used extensively for checking on the flood position and the dropping of food supplies. The equipment allowed contact with the aircraft at any time. VK2AA co-operated with and assisted amateurs as did the Army authorities.

A week later, with the whole Lachlan Valley saturated and with some areas still flooded, rising levels over the spillway at Wyangala Dam indicated that Forbes would again be seriously flooded. Amateurs in the area again prepared, so they could render assistance if required.

At the request of the local PMG Engineer, Mr. Carter, John Meagher, VK2AMV, set up his main station equipment at the family store in the centre of the town. Here, an auxiliary AC generating plant could provide power in the event of town's supply failing, then Forbes could be kept in contact with the

outside. Serious floods divide Forbes into three areas, and John spent a week on his island waiting to assist if required.

To Hugo Stitt, VK2WH, went the jobs of "mothering the 'ducks'" which had been despatched to the area for relief work. He was able to contact them when they were operating in many towns in the valley.

The Army "ducks" which use either 3BZ or 22 transmitter/receivers were operating on different frequency in different areas.

At the request of VK2WH they were all lined up on the emergency frequency of 7002 Kc. The procedure proved very successful, as it allowed the fullest use to be made of amateur stations and the listening-out facility they provide. At any stage, there was always one station, by view of his location, could provide fills for messages transmitted by the "ducks." This allowed the full text of all messages to be relayed to the Army authorities.

VK2WH also handled traffic for the PMG Department when stations 91C/P and VL2AA in Parkes required messages to be passed to the postal authorities in Forbes. The direct Parkes-Forbes telephone link was damaged by the flood.

Bill Kennedy, VK2BT, of Eugowra, 23 miles east of Forbes, was also active when the town was completely isolated for a number of days. He stood by, should emergency traffic handling be required. Many bands were used during the operation, but main work was performed on 7002 Kc and the 144 Mc band.

Many amateurs assisted at various stages, John Miller, VK2ANF, kept a continuous watch on the emergency frequency and his work was invaluable.

Other stations rendering assistance included: VK2ADT, VK2AWY, VK2SN, VK2ALX, VK2TC, VK2JV, VK2ACT, VK2IH and VK2BQ.

In the flooded area the mains voltage was often down to 150 volts and only by the judicious jamming of relays was equipment kept on the air.

In view of the urgent requests for the dropping of food stuffs to isolated parties, it was decided not to carry the 144 Mc gear because of the weight of the battery required to operate it. 90lb of food was a more important air cargo. At times, too, the aircraft were required to land in the streets of Forbes and weight carried was very important.

Although amateur stations during the emergency were not called upon to handle much traffic, they were available should the position have deteriorated in any area. They spent an aggregate of hundreds of hours listening out.

WWV TRANSMISSIONS

WWV station of the US Standards Bureau, which transmits standard frequency signals, recently changed its method of indicating ionospheric conditions.

Previously the letters—N—for unsettled and —W—for give warning of a disturbance, were used. A figure code is now added showing the degree of upset expected to occur to the normal propagation conditions.

The code is rather like our S code, and runs from 9—indicating excellent propagation conditions, down to 1—showing impossible propagation conditions.

If you hear the combination N9 you can expect DX as predicted should come through, if you hear U1, you can smartly retire to bed. The service should be valuable in view of the poor conditions experienced at the moment; a check on WWV could save many hours of unsuccessful operating.

The code is transmitted at 29, and 49, minutes past each hour on 2.5, 5, 10, 15, 20 and 25 megacycles.

The best Voice of America special amateur radio broadcast presented by Bill Leonard, W2SKE, received here, commences at 2145 hours EAST on Sunday. The program runs for 15 minutes and the station is KWIV, San Francisco, operating on 9.57 Mc. A special propagation bulletin covering amateur bands is given each week and is prepared by George Jacobs, W2PAJ, VOA ionospheric expert.

The MARS Organisation (Military Amateur Radio System) is receiving considerable support in the US. The Army and Air Force signal authorities are making the organisation as attractive as possible and any amateur over 21 years of age can join. It is fully appreciated how valuable the service of amateurs can be in emergency and it is anticipated that this service will be drawn upon heavily in such circumstances.

The objects of the service are to create interest, and further train operators in military radio communication.

To co-ordinate practices and procedures of amateur radio operations with those of military radio communication.

To provide an additional source of trained radio communications personnel in the event of a local or national emergency.

Stations operate on special military frequencies allocated for the purpose using military procedure. Special attention is paid to CW operation, as it is stated, there is no equal to this method of communication under marginal conditions.

ITEMS OF INTEREST FROM OVERSEAS

AMERICAN stations have a new TVI problem on their hands with the opening of the 21 Mc band. It is one of direct interference to the IF channel on the sound sections of TV receivers.

Soon after the war, the industry decided that anywhere between 21.25 and 21.9 Mc would be suitable for the sound IF channel, and such a standard was adopted.

The ARRL immediately pointed out that portion of the selected range was in the then newly proposed 21 Mc band for amateurs. Manufacturers however did not heed the warning, as the problems of TVI had not been experienced then. Some millions of sets were produced, many of them with intermediate frequencies between 21.25 and 21.45 Mc.

To prove the trouble that could be expected from direct interference, in 1948 the ARRL conducted a series of experiments. These clearly showed that extensive interference could be expected when amateur stations used 21 Mc; complete blanketing of the sound transmissions was noted even at a distance of a few miles.

Fortunately, it has been found possible to tune the IF's to a frequency outside the amateur band limits. This action, plus, on occasions, the use of a high pass filter rectifies the interference.

As the interference is caused by a condition of the receiver, the owner is responsible for its corrections, but education of the public to this point is required.

As many hundreds of thousands of viewers are likely to be affected, it will be necessary to foster public support for such a widespread change. The job can

be done by any competent radio serviceman.

New receivers fortunately are now using a sound receiver IF of 40 Mc, as all forms of interference were being experienced using the 21 Mc IF's.

The W's certainly seem to be experiencing their share of TVI worries.

The next International Telecommunications conference is scheduled to take place in Buenos Aires this year.

It has taken a long time to implement the decisions of the last one, we, for instance, have just received the 21 Mc band allocated at Atlantic City in 1947. Some of the commercial HF allocations won't be made until 1954.

Present indications are that no administrative radio conference will be held this year, however there will be a plenipotentiary conference called. The agenda will possibly only cover ITU organisational matters, and will contain nothing of direct interest to amateurs.

The G's incidentally were permitted to use the 21 Mc band as from July 1, operation restricted to CW only between the frequencies of 21,000 and 21,200. No news is available on when they will be allowed to operate on the rest of the band.

The RSGB is still pursuing discussions with the GPO on the subject of commercial interference on the 7 Mc band. Latest addition is a Pakistan B/C station within the exclusively amateur allocation 7010 Kc. Transmitting a special program beamed to England. As pointed out it may be years before commercial allocations around these frequencies are sorted out according to Atlantic City. The 80-metre gang have had their own brand of commercial interference of late.

W.I.A. NEWS

ANGUS ROBERTSON, VK2IQ, lectured at the May meeting of the NSW Division of the WIA, his subject "The Interpretation of Ionospheric Charts." With the aid of diagrams and illustrations prepared and projected by Joe Reed, VK2JR, Angus presented a first rate lecture of great interest to amateurs. His special comments on interpreting the charts for 21Mc was well received.

It was found necessary to double the membership rates for this year and in view of this fact, it is gratifying to the council to find that over 70 pc of the membership are financial in under three months. Early payment greatly eases the work of the treasurer Stan Owen, VK2RX, and secretary Dave Duff, VK2EO.

Winners of recent contest run by the NSW UHF section were as follows: 144 Mc DF Field Day: First, VK2AAA, Army Signals Radio Club; second, Bob Winch, VK2OA. 144 Mc Scramble: Harry Solomons, VK2AJZ, and Bert Beresford, VK2ABB, tied for first place.

The Hunter Branch of the WIA are co-operating with the Newcastle Technical College in their new class for prospective amateurs. 23 members are studying for their AOCF and it would appear as if Newcastle will have an influx of new calls in due course.

DX & PERSONAL

A VERY rare prefix appeared recently on 20 metres, so rare, that it has never been heard before. The prefix is VR7, and there is quite a story about it, too. VR7AB arrived at Naura as an operator for commercial station GTG and he is there for a period of two years. He operated in Scotland as GM3DOJ, mainly using the UHF's. According to the story the postmaster on Naura is seizing all his amateur mail as he had no knowledge that VR7AB is permitted to operate, although the latter assures his contacts that it was all arranged before he left home. The VR7 prefix has never been allocated to date, and it would appear that a VR1 prefix would be more in keeping for the island which is very near or in the Gilbert Islands. Jim Cowan, VK2ZC, reports that VR7AB will be asking Jim Corbin, VK2YC, NSW QSL officer, to handle his inward and outward cards until the position is clarified. Most of the DX gang have their fingers crossed and hope that VR7AB receives official sanction, as in the VR7 prefix there is hope for a new country.

The EA8 gang also provided DX gatherings with a new country when they journeyed across to Ifni, Spanish West Africa. Signific EADFC they provided many stations with a new one.

A number of cards forwarded to VQ4RF for VQ1RF Zanzibar contacts made late last year are being returned. Although VQ1RF made 1200 contacts in 80 countries during his stay on the island, the call sign was extensively pirated during the period. Cards returned indicate that the unofficial VQ1RF must have had as many contacts as the official one. It must be a great temptation to pound a key using a VQ1 prefix.

KJ6 QSL cards are fairly scarce and KJ6AR 14.095 Kc is often about at 0900 hours EAST. Frank is a new operator and appreciates his Morse at about 12 wpm. HH cards also are a scarce commodity and HH2FL 7030 Kc can be contacted around 1800 hours EAST.

Frank Nolan, VK9FN, ex-VK4FN, and well known as an operator of VK4WI can be heard on 3.5 Mc and is looking out for old friends. Worth contacting for an extra one for the Empire DX Certificate if you are short a VK9. Frank should be good for a QSL!

YOUR OPPORTUNITY

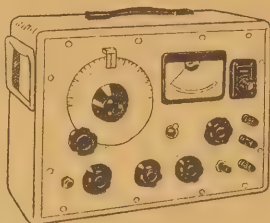
to join the world-wide ranks of amateur transmitters! The Wireless Institute of Australia holds regular classes in Sydney to assist Sydney and suburban enthusiasts to obtain their Amateur Operators Certificates of Proficiency.

Write for particulars to the Class Manager, W.I.A., Box 1734, G.P.O., Sydney.

Radio and Hobbies, August, 1952

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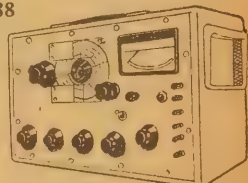


AUDIO TESTER Type TF894

Tests on all types of audio equipment are simplified by this instrument, which provides a stable beat-frequency oscillator, with accurate output attenuation, and an audio voltmeter in the one unit. Frequency range—50 c/s to 12 kc. Output—300 mW max., into 600 ohms ladder attenuator. 0 to 50 db, or 5000 ohms direct, continuously variable. Audio Voltmeter—0-10, 0-20, 0-40, 0-80 Volts r.m.s.

PORTABLE RECEIVER TESTER Type TF888

A wide-range signal generator, a tone source of variable level and an audio-output power meter, combined in one compact assembly, either mains or battery operated. An internal crystal oscillator is provided for standardisation. Frequency range—70 Kc to 70 Mc in eight bands. R.F. Output—1 uV to 10 mV at 80 ohms, or 500 mV at 40 ohms. A-F Oscillator—Frequency nom. 1 kc. Max. Output 12V. Modulation—cw, internal 1 kc at 30%, or external. OUTPUT METER. Power range—10 mW, 100 mW, 1 W full scale. Input Impedance—3 ohms, 33 ohms, 150 ohms, 600 ohms.

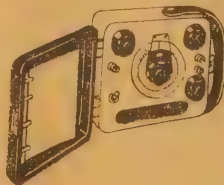


VALVE VOLTOHMMETER Type TF887A

Field tests are readily made with this volt ohmmeter, as it is readily convertible for operation on either internal batteries or mains power. The switching caters for checking the battery voltage, thus ensuring accuracy. External multipliers are available to extend the voltage ranges. Ranges—0-5, 25, 125 V AC, 0-5, 25, 125, 250 V DC. Input resistance—25 megohm for dc, Resistance—0.5 ohm to 2 megohm.

VALVE MILLIVOLTMETER Type TF899

Measurement of small r-f or a-f voltages is enabled by this instrument. A jack is provided for earphones so that the meter may be used as a signal tracer, without disturbing the circuits under test unduly. Another common use is the determination of gramophone pick-up characteristics. Ranges—0 to 150 mV, 500 mV, 2 V. Frequency response—50 c/s to 50 Mc plus-minus, 1 db, 50 c/s to 100 Mc plus-minus 2 db.



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A very compact portable frequency meter, designed both for setting up the frequency of transmitters and for checking the calibration of receivers. The fundamental bands are 100-200 kc and 1000-2000 kc/s, but a continuous cover of 100 kc to about 25 Mc may be secured by the use of harmonics.

For further details, write, 'phone or call

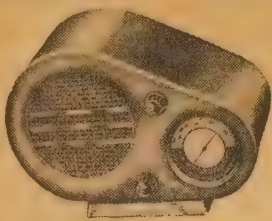
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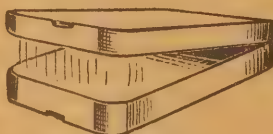
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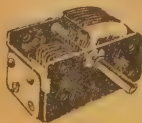


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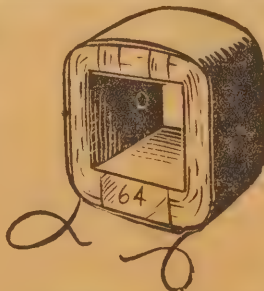
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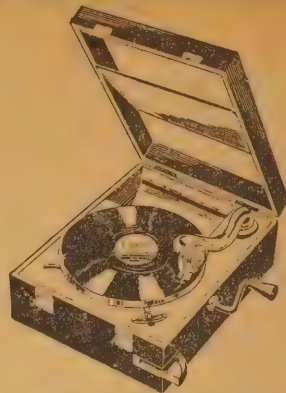
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TRUE WIDE-BAND A.M. TUNER

(Continued from Page 53)

overlap at each end of its travel as the drum turns the gang capacitor from maximum to minimum capacitance setting.

Tune in the signal from the oscillator and, if necessary, adjust the slug in the oscillator coil until the signal appears at the correct position on the dial.

Leaving the signal tuned in accurately at this spot, shunt a resistor of about .025 meg value across one of the aerial coils, either underneath the chassis or on the gang section itself.

AFFECTS AVC

Most likely you will notice the audio output increase as you do this because the .025 meg resistor will virtually short out the AVC action. In the circumstances, keep the input signal from the oscillator down to avoid possible overloading of the first valve grid.

Adjust the slug in the aerial coil NOT shunted by the .025 meg resistor for maximum signal output. Remove the resistor, shunt it across the aerial coil just aligned and adjust the slug of the other aerial coil for maximum signal output. Now remove the resistor entirely.

Set the service oscillator to about 1200 Kc, tune its signal in and adjust the trimmer across the oscillator section of the gang until the signal appears at the correct spot on the dial. Adjust the trimmers across the other two sections of the gang for maximum signal output.

It would be wise to go through the alignment of the bandpass aerial coils once again because achievement of the full performance from the tuner depends upon reasonable adjustment of the tuned circuits.

If you watch the output meter when tuning across a signal from the service oscillator set to around 600 Kc, you will probably notice two small "peaks" set a little to each side of the centre tuning point. This is a characteristic of a bandpass circuit and indicates the desired broadness of the tuned circuitry.

WITHOUT INSTRUMENTS

Now let's deal with an alignment procedure when a service oscillator and an output meter are not available.

More than likely the IF transformers will be set fairly close to 1.9 Mc and so the first step will be to set the 6AN7 oscillator circuit. To do this couple an aerial to the tuner and try to tune a station near the low frequency end of the band, that is, around 600 Kc.

Identify the station and, if necessary, adjust the oscillator coil slug until the station is tuned in at its correct spot. Roughly align the aerial coils for maximum response with the aid of the slugs.

Swing the dial down to a station towards the high frequency end of the band, around 1200 Kc. identify it and, if necessary, adjust the oscillator gang section trimmer capacitor until it appears at its correct spot. "Peak" the trimmers across the two other sections of the gang for maximum response from this station.

If this station is being received strongly, tune to a much weaker one close by on the dial. Adjust the slugs protruding from the top and

bottom of each IF transformer for maximum response.

Now go back to a station near the other end of the dial around 600 Kc and shunt one of the aerial coils with a .025 meg resistor in the manner already mentioned.

Because this action temporarily upsets the AVC action, lightly couple the aerial by removing it from the terminal and wrapping a turn or so around the insulated part until the station is being received weakly or alternatively, select a weaker station close by on the dial.

Adjust the slug in the aerial coil NOT shunted by the resistor until maximum response is heard. Transfer the .025 meg resistor over to this coil and "peak" the other coil for maximum response. Remove the .025 meg resistor.

You may find that some of the adjustments are a little broad, in which case note the two positions of the slug where the signal level begins to drop and set the slug at a point half way between them. Go over these IF adjustments twice.

Swing the dial to a station, preferably a weak one, towards the high frequency end of the band and check the adjustment of the trimmers across the two aerial coil gang section for maximum response.

It would probably be worthwhile

going over the alignment adjustments again just to make sure that everything is as close to being on the dot as you can tell by ear.

Last but not least is the simple adjustment of the 10Kc whistle filter unit. First set the .1 megohm potentiometer to about .02 megohm with the aid of a multimeter and, whilst listening to the 10 Kc adjacent channel whistle adjust the slug in the whistle filter coil until the whistle level drops. With successive adjustments of the potentiometer and the coil slug, you will find that the whistle will disappear.

LIMITING OUTPUT

One final point remains. In areas close to strong stations, the signal available from the tuner will be quite high — many volts, in fact — which means that the volume control on the amplifier won't have to be shifted much to change from "no" volume to "full" volume.

If you find this effect disagreeable, you can add a low value resistor — say 5000 ohms to .01 megohms — in series with the earth side of the .05 meg 12AU7 cathode load. Take the audio output through the filter from the junction point of the resistors rather than from across the entire cathode load.

Alternatively, you could replace the .05 meg resistor with a potentiometer of the same value, taking the output from the moving arm. It could be pre-set to any required level.

DESIGNING A PHOTOFLASH UNIT

(Continued from Page 79)

Likewise the resistors, except the two 10 megohm ones, should be of the half-watt size.

Over the top of all these parts are mounted two tag strips to carry the various minor components and these are attached to the side of the gun by means of countersunk screws in order to provide a smooth outer surface.

Throughout the whole of the construction emphasis has been placed on the need to protect both the operator and the equipment from the high voltages and heavy currents which characterise this type of equipment, and we would once again stress the need to exercise the utmost care when working on it, particularly during the initial experiments.

Even after the tube has been fired the capacitor is not completely discharged, the tube de-ionising when the voltage drops to about 200.

To gain some idea of the energy available you can short the capacitor terminals with an insulated screwdriver to remove this residual charge and we think the resulting "splat" will breed a healthy respect for the device, even though it represents only a fraction of the total energy. It is not advisable to short a fully-charged capacitor since there is a danger of damaging it.

And now for some idea of the performance to be expected from equipment of this type. In order to appreciate this better it is necessary to understand the nature of guide numbers which are often quoted for flash bulbs when used for open flash exposures and for electronic flash units which, by their very nature, always provide an open flash exposure.

The guide number really applies to a combination of the light source and film and is a figure into which the working distance, in feet, should be divided in order to obtain the "f" number, the one remaining factor to be determined. Thus, when working with a guide number of 60, it would be necessary to use a stop opening of f10 when the subject was 6ft from the light source.

Our experiments were conducted with Super XX roll film (not 35 mm) processed in Microdol fine-grain developer for the normal time recommended by the makers. On this basis it would seem that a 27 mfd condenser at 2000 volts should be given a guide number of 60.

EXTRA DEVELOPMENT

Where the size of the negative is such that grain is not critical, standard developers could be used with some increase in these figures, probably amounting to about half a stop. Again, the use of faster films, such as the press pan types, would raise the figure still further, particularly as these negatives are usually large enough to permit processing for maximum speed without regard for grain.

Quite naturally the individual worker will have to experiment in order to establish a guide number to suit his own equipment, choice of film, and method of working, but the above should provide a useful basis for experiment and give some idea of what results to expect.

Next month we hope to have some more to say about these units, covering such matters as lighting angles, reflectors, fitting contacts to the camera, checking synchronism, and so forth.

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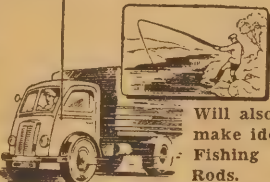


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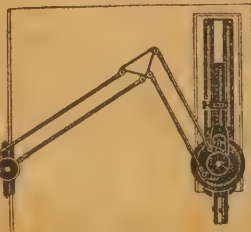
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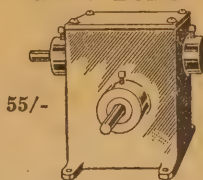


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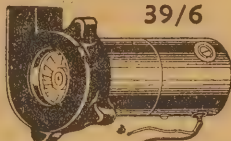


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Spanners, 35/-, 1 1/16 x 1 1/8, 37/6
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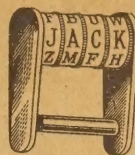
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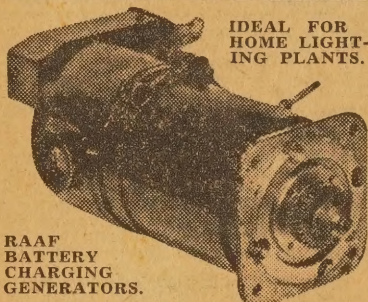
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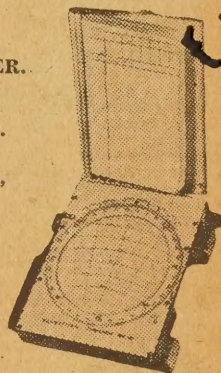


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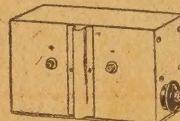
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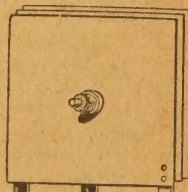
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6 volt 4 amp, 39/6. Transformers to suit above Rectifiers, 2 amp, 37/6.
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ANSWERS TO CORRESPONDENTS

R.F.W. (Oakleigh, Vic.) is thinking of building "Tom Thumb" from Radio and Hobbies for August, 1947, but he would like to use a loop aerial or a whip aerial.

A. A tuned loop would probably give reasonable results, although the signal pickup would not be as good as with a long aerial. A loop aerial was used with "Tex," described in the February, 1947, issue. It was wound around a wooden case, 6 1/2 in x 5 1/2 in, outside dimensions, and consisted of 24 turns in the case of the tuned winding and 10 turns for the reaction winding. Both coils were wound with 30-gauge silk-covered wire and spaced 1-8 in apart. The aerial winding can be tapped every five turns to allow the connection of an external aerial if desired. The solid dielectric condensers you mention are no longer available largely because they proved less efficient in practice than air dielectric types. Some air dielectric condensers of comparable size and capacity are now available, however.

M.W. (Waverley, NSW) is not able to receive anything on his crystal set and wonders if the trouble may be due to his aerial and earth system. The aerial is only 26 ft high and he finds it necessary to use an earth wire 50 ft long.

A. You do not say how long the aerial actually is, so that we are not in a position to make even a rough estimate of its signal pickup. The long earth wire is a disadvantage but, given a reasonable length of aerial, it should be possible to get some results. We suggest that you try testing the set on some other aerial, say, at a friend's place, to make sure that the trouble is not in the set itself.

K.A.D. (Everton Park, Qld.) wants to know if we can supply a diagram of a signal generator which has seven fixed frequencies covering the intermediate frequency bands and the ends and centre of the broadcast and short-wave bands.

A. Sorry, K.A.D., but we have no circuits on our files of the type you require and we cannot undertake to produce special circuits for individual readers. In any case, we think you would find a more conventional type of oscillator a much more satisfactory proposition and we could supply you with several circuits of this type through our postal service.

A.W.N. (North Otago, NZ) raises a point about AC signals in valves and wants to know if we can clarify the matter for him.

A. Your letter has been forwarded to the "Answer Tom" department and will be dealt with in the near future, the required explanation being rather too involved for these columns.

D.J.B. (Nambour, Qld.) is interested in the Playmaster series and makes some inquiries about their suitability for recording, particularly on tape.

A. The main item lacking with the set-up you propose is some means of providing the required recording characteristic which will have to be adjusted according to the type of recording, i.e., disc or tape, and also with due regard to the playback characteristic, particularly on tape. For this reason the No. 2 control unit, having a measure of independent bass and treble control, would be more suitable, though it is probable that more compensation than this would provide may be necessary for tape work. It is difficult to say whether the layout you propose would be satisfactory since much depends on the field around the motor, &c., but, in general, we feel that there would be some risk of trouble. Regarding the experience in servicing, we can only suggest that you follow the various articles in R. and H., particularly the "Serviceman Who Tells," and do as much testing as you can on your own gear, even when it is working correctly, in order that you may familiarise yourself with normal operating values.

P.C.B. (Bellevue Hill, NSW) writes to tell us the excellent results he has had with the "Fifty-Four," which was described in Radio and Hobbies for June, 1950.

A. Many thanks for your report on the performance of this set, P.C.B., and we are very pleased to learn that you have had such success with it, particularly in view of the limited facilities which you had available. We were also pleased to receive the enclosed paragraph and to know that you find the magazine in general so interesting.

R.D.K. (Berrie, SA) forwards 12 months' subscription and expresses his appreciation of the articles in Radio and Hobbies, being particularly interested in the transmitter and modulator articles.

A. Your subscription has been forwarded to the appropriate department, R.D.K., and we are glad to hear that you find the transmitter articles so interesting. We hope it will not be long before you are able to realise your ambition to obtain your "ham" licence.

G.R.A. (Five Dock, NSW) wants to know if we could publish construction details of a soldering iron of the quick-heat variety.

A. We have done no work along these lines and so have no details for publication. Actually we doubt whether the home construction of these units would be a proposition but if any readers have done any work along these lines they may care to submit them for the "Reader Built It" page.

A.P.S.J. (Piliyadale, Ceylon) is interested in the Four Band Transmitter and wants to know if we can quote him a price for a complete set of parts and obtain them for him.

A. We regret that we cannot undertake to obtain price lists or kits of parts on behalf of readers, who should approach the dealers who advertise in the magazine and are equipped to undertake this class of work.

R.P. (Urbenville, NSW) writes to thank us for some information recently forwarded and to comment favorably on many of the articles in Radio and Hobbies. He also mentions that he has constructed about 20 of our smaller sets and is particularly happy about the performance of the "Baby Record Player." Main problem at the moment concerns the repair and installation of electrical fittings in the home.

A. Many thanks for your comments R.P., and we are pleased to learn that you have found the various articles so interesting and have had such success with the projects. You should consult your local power supply authorities for details of wiring regulations, but, in general, such authorities require that licensed electricians only be allowed carry out repairs or installations. Any contravention of these regulations could result in disconnection of the supply. There is also the question of insurance any tampering with house wiring which results in a fire would possibly void any claims on the company. From a more practical point of view it must be appreciated that such installations, made by people who think they know but do not, can be very dangerous to life.

S.R. (Elwood, Vic.) wants to know if we have any designs for radio control of models.

A. A series of three articles on this subject appeared in Radio and Hobbies for September, October, and November 1950, but, unfortunately, these copies are no longer available from this office. However, you may be able to borrow these or obtain photostats from your public library.

B.W.D. (Palm Island, Qld.) writes to thank us for some circuits recently forwarded to him and also to tell of his success with the "Playmaster No. 2 Amplifier." He also registers his approval, together with two associates, of the Amplifier Handbook idea.

A. Glad to hear of your success with the Playmaster, B.W.D., and that it has proved suitable for use with your microphone and guitar mixing circuit. Many thanks for your kind remarks about the magazine and we have noted your approval of the Handbook idea, which seems to have been very well accepted.

L.P.S. (Herston, Qld.) submits a circuit which requires to be altered to suit a tentative types of valves.

A. Sorry, L.P.S., but this is the type of query which we just cannot handle since it would involve a considerable amount of design work. However, our impression is that the valves you mention would be unsuitable since they have directly heated, battery operated, filaments, while the 6AD7 is an indirectly heated, AC operated, type. Since we have no idea of the purpose of the amplifier or the conditions under which the valves will be operating it is impossible for us to comment further.

THE "RADIO & HOBBIES" QUERY SERVICE

ALL queries concerning "R & H," designs, to which a **POSTAL REPLY** is required, must be accompanied by a postal note or stamps to the value of **TWO SHILLINGS**.

For the same fee, we will give advice by mail on radio matters, provided the information can be drawn from general knowledge. **UNDER NO CIRCUMSTANCES**, however, can we undertake to answer problems involving special research, modification to commercial equipment or the preparation of special circuits.

Whatever the subject matter, we must work on the principle that a letter is too involved if, the reply takes more than 10 minutes of our time.

Queries not accompanied by the necessary fee will be answered **FREE** in the columns of the magazine and presented in such a way as to be of interest to other readers.

To those requiring only circuit reprints, &c., we will supply for **TWO SHILLINGS** diagrams and parts lists from our files covering up to three "R & H" constructional projects. Scale blueprints showing the position of all holes and cutouts in standard chassis will now be 3/6. These are available for nearly all our designs.

Address your letters to The Technical Editor, "RADIO and HOBBIES," Box 2728C, GPO, Sydney.

Note that "RADIO & HOBBIES" does not deal in radio components. Price quotations and details of merchandise must be obtained direct from our advertisers.

J.H. (Bathurst, NSW) writes to suggest that we publish details of a power pack to permit portable sets to be operated from the mains when available.

A. A unit along the lines you suggest was described in *Radio and Hobbies* for October, 1948, and a circuit and parts list is available through our postal service, although the original issue is, unfortunately, no longer available. Glad to hear that you have had so much success with the various *Radio and Hobbies* circuits which you have built.

J.C. (Speers Point, NSW) describes a circuit which has terminals for phones or speaker and wants to know what type of speaker would be required.

A. Unfortunately the information you have supplied is rather inadequate, J.C., and we find it difficult to help you. In general a speaker should be chosen to suit the impedance of the output valve which is done by selecting the correct speaker transformer. This is normally regarded as part of the speaker. The size is only important as far as the physical requirements are concerned, but the larger the speaker the less power it will require to produce a given volume of sound. In some cases the transformer is treated as part of the circuit and will be specified as having certain characteristics and probably for a certain speaker voice coil impedance. If you care to let us have some more details we may be able to help you further.

J.W.W. (Edgecliff, NSW) sends details of a HT supply for use with a CEO unit and which he is using on his own equipment with considerable success.

A. Thanks for your circuit and details, J.W.W., and we are passing these on to our "Reader Built It" section for possible publication at a later date. As you say, it will possibly be of interest to many readers and the results you have obtained should also prove valuable.

J.H. (Singapore, Malaya) writes to tell us of his success with the two-valve transmitter described in the October, 1948, issue of *Radio and Hobbies*. However, he is anxious to obtain some information on coupling a VFO to the first stage.

A. Many thanks for your very kind remarks, J.H., and we are very pleased to note that the little transmitter has worked out so well. We hope to be able to publish some information on VFO's before too long. In the meantime, the generally accepted method is to connect a broadly tuned circuit to the grid of the valve and link-couple the circuit to the output of the VFO. Separate coils will, of course, be required to accommodate VFO's having different output frequencies. If the crystal oscillator is arranged for "tritet" operation it will be necessary to short the cathode coil when using the VFO.

R.H.B.W. (Forbes, NSW) forwards an advertisement for inclusion in *Radio and Hobbies* and also has some comments about the current series of articles by the "Serviceman Who Tells" on typical test equipment.

A. The "Serviceman" discussed the subject of signal tracers in his article for February, 1952, covering the uses of these devices, the requirements of a professional serviceman, and the general categories into which the various commercial types could be placed. He also gave some idea of the technical problems involved in the design of such an instrument and suggested the general form which an instrument might take to overcome them. We were not able to supply a suitable circuit from our files to go with this article, as we have done with most others, simply because we have not to date done any practical work along these lines. However, we are keeping the idea in mind and may do something in the near future.

H.W.McQ. (Punchbowl, NSW) was apparently interested in the recent "Let's Buy An Argument" feature on color and submits a question for consideration.

A. Many thanks for your letter and your question will appear, if space permits, in the July issue.

B.S. (Ipswich, Qld.) is one of many readers who is very keen to see us produce an amplifier handbook. He says that he has constructed receivers ranging from "Tom Thumb" to the 1950 Radiogram and the "Karset," all with excellent results. He is worried, however, because there appears to be a "gooey substance" oozing from the head of his crystal pickup near the stylus arm.

A. We were pleased to hear your report on the receivers you have constructed and they certainly make an imposing list. We would not worry at all about the "gooey substance" as this is quite likely part and parcel of the "damping" which is provided in most pickups. What supports this is the fact that the performance of the pickup is apparently unaffected. Your remarks about the "Off the Record" columns have been noted.

A.L.K. (Mungungo, Qld.) contributes some ideas about the design of hearing aids and thinks there would be a place for both an AC-operated unit and one operating from batteries, using parts commonly employed in personal portable receivers.

A. Thanks for your letter, A.L.K., and for your ideas on the subject. Other readers have mentioned the "not so miniature" battery job but we have serious reservations as to whether such a device would be useful in practice.

M.F.F. (Erskineville, NSW) has a number of records which have warped during the hot weather. He wonders if it would be possible to restore them to their original condition and also asks our advice on record storage generally.

A. It should be possible to get the records back to an acceptable condition. We suggest that you store them in a warm place between two flat surfaces, say, two pieces of wood. The weight of a few books can be used to speed the process. It is generally conceded that the most satisfactory way of storing records is to place them on end after the fashion of books in a bookshelf. The chances of them becoming warped when stored thus are slight and it is possible to obtain the desired record without disturbing a large pile.

R.C.M. (Cryon, NSW) would like to obtain details of a radiogram to operate from a 32-volt lighting plant. He also inquires about the possibility of obtaining a motor to operate from the same supply.

A. An excellent 32-volt vibrator receiver was described in the October, 1950, issue of *Radio and Hobbies*. The input of the audio amplifier is suitable for pickups other than the very low input magnetics. Some excellent 24 and 28-volt motor generators have been advertised by the various disposals dealers. Many are rated for a continuous output of 250 volts at 60 mA, which makes them a good proposition for a receiver like the 1952 Advance. You would need to make special arrangements about the filament network and a series resistor would be needed to adjust the primary supply to the correct value. Fred A. Faulk Pty. Ltd., who advertise in *Radio and Hobbies*, may be able to supply a 32-volt turntable for 78 rpm. However, it would be a governor type and may not be satisfactory when governed down to 33 1/3 rpm. Other than modifying the gearing system of the turntable itself, the best we can suggest is that you use one of the special reduction turntables now available. Your remarks re R. and H. are much appreciated.

R.A.L. (Randwick, NSW) built the "Senior Radiogram" some years ago and up until now he has been very pleased with its performance. However, lately it has developed the fault of coming on with a "plonk" after warming up. It is quite normal afterwards. The converter valve has been changed but with no change in the results.

A. It would appear that the trouble is connected with the oscillator section of the converter valve, but to make sure we would suggest that you connect a 0.1 mA meter between the end of the .05 meg. resistor and earth. You will then be in a position to observe whether the oscillator coming into operation corresponds with the "plonk." If so, a number of components could be suspected, but we would place the 8 mfd. bypass condenser on the top of the list. Otherwise it will be a matter of working through the set a stage at a time to isolate the trouble. You can render the various stages inoperative simply by pulling the valve out of its socket. We would suggest that you start by pulling out the 6J7-G phase splitter and, if necessary, working right through to the front end of the set. Having isolated the trouble, you may need a multimeter to detect the faulty component. Many thanks for the kind remarks regarding *Radio and Hobbies*.

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Cost of Classified advertisements in this section is 2/- per line; approximately five words to a line.

FOR SALE: Stamp collectors, my sets and singles for beginners or medium collectors are the "goods" in price and quality. Selections on request. N. Cleary, St. Andrews, Victoria.

FOR SALE: Three cameras, Kodak A-130, Brownie Reflex 127 with flashgun, Coronet 8MM Midget. The lot, £7. One STC 4 v. Personal Portable, £10, one Buk Electric Shaver, £5. Write: T. Williamson, 16 Adele St., Yass.

FOR SALE: AT20 Transmitter, 2-20 MC. Ideal CW Rig., good condition. Weight 13 1/2 lb. Can arrange road transport to Sydney. John Meagher, VK2AMV, Forbes.

FOR SALE: HRO Receiver covering, 480 kc/s to 30 mc/s by 6 coils. Uses 4 6D6, 3 6C6, 1 ea 6B7, 42's and 5Z3 tubes. Bendix BC221T frequency meter, complete with calibration book. 2 866A, 1 ea 813, 804 and 83 tubes, 1 7.1 mc/s Xtal and 1 Bailey 1000 Kc/s Xtal Octal based. Write: D. Dixon, 64 Berwick Street, Guildford, NSW.

FOR SALE: Latest model Hallicrafter Communications Rvrv. S-40B. 8-valve, 540 Kc, 44 mc. Like new. Best offer. Like new, Edition "Practical Radio Communications"—Nilson & Hornung, £1/10/-. Valves, mostly new: 6H6, 6V5, 6AL5, 6AK5, 6AK6, 6K6G, 6SN7, 5Y3, 6SK7, 6J57, 6V6, 5W4, 50L6, 25L6, 6A8, 6SA7, 9001, 6B8, 10V4, ea. 2E24, £1 ea. A. Ingham, 43 Connells Pt. Rd., Sth. Hurstville, Sydney.

SELL: Rola 12U Speaker, £10; matching Ferguson OP25, £4; Redline AF15 Trans. unused, £8; Two Decca Hi-Fi Pick-ups, £7 ea., Decca Head Diamond Stylus, £7. XM3712.

SELL: Williamson Amplifier and Garrard Auto Changer, £30. Or offer. XL3373.

SELL: N.80 Crystal Mike and Stand, £5. Simplex Auto Key, £3. Crystals, £1. Meters 807's, etc. 6 Gore St., Arncliffe.

SELL: One Radio, Four Speakers, quant. Parts. J. Bray, 6 Rawson St., Sans Souci.

SELL: 5in C.R.O., R&H Design. Excellent condition. Spare tube, £19 or offer. Wheller, Underwood St., Forbes.

SELL: No. 11 H.P. and L.P. Genemotor 30/- ea. 6v Vib. unit, 135v. output, £3. Cruice, Woodford, Queensland.

SELL: One X.O.A. University Oscillator in perfect order. Have no further use for same, price £18. Apply: 17 Tripod St., Concord.

SELL: One English No. 11 Transceiver, complete as new, 1 A.W.A. No. 11 complete. Both are guaranteed in first-class order or money back or would exchange for Straight Receiver. G. Marsden, 41 Bogan St., Parkes.

WANTED: A 6-pin Socket and Retaining Ring for RAAF Indicator type A1 power input. Circuit of Indicator, hints for easy conversion to C.R.O. R. Gibb, Chemist, Corral, NSW.

WANTED: R.M.E. 69 Handbook Circuit. Simpson, 27 Legge St., Lakemba.

DO you Want Help by building that set? Radio technician wants to help you, 7/- an hour and travelling expenses. After 5 o'clock or weekends only. Write: Box 6 P.O., Guildford, NSW.

EXCHANGE: Port JAP Xmitter, 6 Xtals and Receiver Radio Parts for No. 11 set. Write: 89 Victoria Av., Mordial, NSW.

A CIRCUIT WITHOUT WIRES

(Continued from Page 71)

Notice, too, that the shortest one oscillates at a faster rate than the others. If you care to count the time it takes for, say, 10 vibrations in each case with the aid of a watch you will be able to work out the time it takes for each vibration. If you do this you will be able to verify that the longer the string the longer it takes to complete a vibration.

If now you attach three similar weights to the horizontal piece of string by three more lengths of string each corresponding to one of the original lengths you will be able to carry out another experiment which illustrates a phenomenon known as resonance.

Make sure that the whole system is perfectly still and then give one of the weights a gentle push and observe very carefully what happens to the other weights. After a few seconds you will notice that they will all begin to move but one of the weights will begin to oscillate backwards and forwards by quite a large amount. The interesting fact is that the one which will vibrate is the one of the same length as the one which was originally set in motion.

Try the same procedure with either of the others and you will find that the weight supported by the piece of string of the same length will begin to vibrate in sympathy while the other two will move very little.

We can arrange an electrical circuit in a radio receiver with two components, a coil and a condenser, which will resonate at the frequency

of the transmitter we wish to hear and exclude the other stations that we do not wish to hear.

The simplest practical radio receiver we can make, therefore, consists of (1) a pair of headphones for converting electrical impulses into audible sound, (2) a crystal detector for rectifying the electrical impulses received by the aerial so that they are suitable for operating the headphones, (3) a tuned circuit to select the required signal from the many signals received by the aerial.

Our task next month is to translate the ideas we have just discussed into practical terms. With a pair of headphones, a crystal detector and a coil and condenser it is possible to construct an excellent radio receiver which will give reception of stations within a radius of 15 miles or so of your location.

A crystal set does not require any batteries and, therefore, does not cost anything to run. As a matter of fact there is no reason why the set should not be left on all the time; you simply put on the headphones when you wish to listen in.

Even if you have never built a radio before and know nothing about radio other than what you have read in this article, you will be able to make an excellent job of the set. Here is an excellent way of learning about radio by building one for yourself. Don't miss next month's issue!

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